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FUGRO NATIONAL INC LONG BEACH CA

MX SITING INVESTIGATION GEOTECHNICAL EVALUATION OF LUKE BOMBING--ETC(U)

JAN 78

F04704-77-C-0010

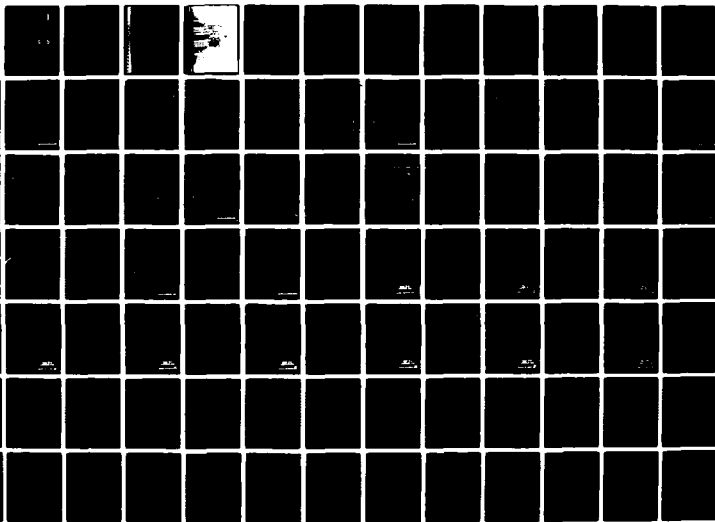
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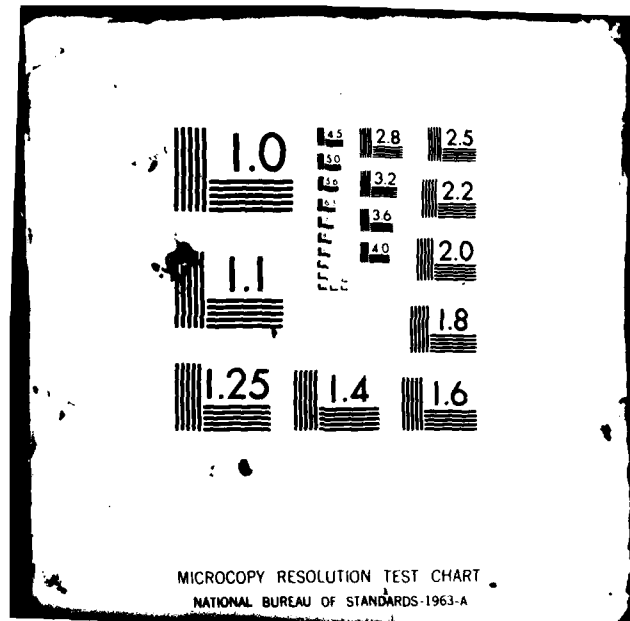
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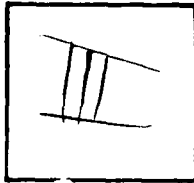




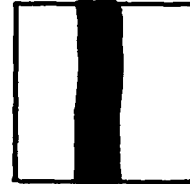
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MX SITING INVESTIGATION
GEOTECHNICAL EVALUATION OF
LUKE BOMBING AND GUNNERY RANGE
GEOTECHNICAL REPORT
LECHUGUILLA DESERT, ARIZONA
VOLUME III
APPENDIX B

Prepared for:

Space and Missile Systems Organization (SAMSO)
Norton Air Force Base, California

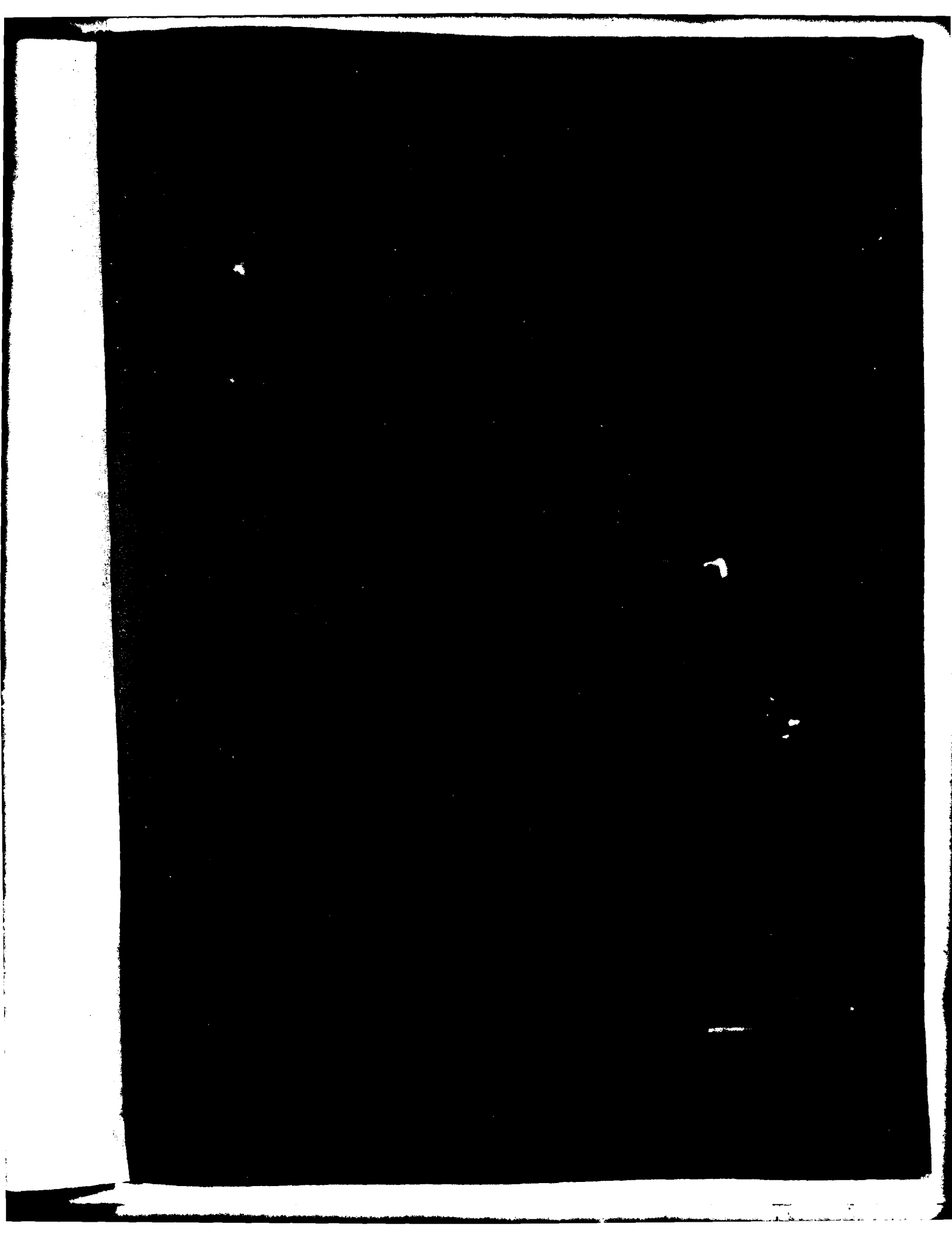
Prepared by:

Fugro National, Inc.
3777 Long Beach Boulevard
Long Beach, California 90807

20 January 1978

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) Max Siting Investigation, Geotechnical Evaluation of Luke AFB Bombing and Gunnery Range, Lechuguilla Desert, Arizona. Data includes Rock Descriptions, Geologic Cross Sections, Microrelief Profiles and physical Properties description.		



APPENDIX B

B.1 ROCK DESCRIPTIONS

Rocks were classified according to the Colorado School of Mines classification system (Travis, 1955). Descriptions of the major rock types in Lechuguilla Desert (Section 4.5) derived from macro- and microscopic examination of hand specimens are as follows (petrographic terminology after Williams and others, 1954):

B.1.1 INTRUSIVE IGNEOUS ROCK (I1)

Quartz monzonite, fine to medium grained with ten to 20 percent dark colored minerals, holocrystalline texture composed of euhedral to subhedral crystals. The Predominant mineral assemblage consists of plagioclase (9 to 36 percent), potash feldspar (26 to 50 percent), and quartz (27 to 39 percent). Accessory minerals include biotite, epidote, pyroxene, hornblende, and apatite. This rock ranges in composition from quartz monzonite to granite; is fresh to highly altered along structures, and copper mineralization is common along faults, joints, and dikes.

Available data (Wilson, 1933) and field data indicate that two joint sets cut both the igneous and metamorphic rocks. These joints strike generally N10W to N30W and north-south to N40E. Dips vary greatly, but most are near vertical (Tables B-2 and B-3). Some of the joints observed in the field do not fall within these general ranges, but strike generally east-west and dip moderately to steeply to the north or south. These may represent a third, less well developed joint system.

B.1.2 EXTRUSIVE IGNEOUS ROCK (I2)

Extrusive igneous rock does not crop out within the study area. However, olivine basalt/andesite was encountered in borings LD-C-5 and LD-D-2 at 255 feet (78 m) and 850 feet (250 m) respectively. Descriptions of these rocks are as follow:

LD-D-2: Generally fresh to moderately weathered, holohyaline, intersertal texture with interstices between grains filled with crystallites and cryptocrystalline material. Dark gray to black on fresh surface (color index approximately 90-95). Fine grained microcrystalline groundmass with large areas of brown glass in an advanced stage of devitrification. Predominant mineralogy is plagioclase, olivine, glass, and opaque oxide with accessory pyroxene and apatite.

LD-D-5: Moderately to very weathered, holohyaline, trachytic texture, light gray (color index approximately 70-75). Euhedral phenocrysts of olivine typically altered to red iddingsite. Abundant equigranular augite and plagioclase laths in a very fine-grained groundmass. Calcite fills cracks and small vesicles. Equidimensional to slightly lath shaped anhedral opaque oxide and olivine in the matrix. Predominant mineralogy is plagioclase, olivine, pyroxene, and opaque oxide with accessory apatite.

B.1.3 METAMORPHIC ROCKS (M)

Quartz biotite gneiss - gray to dark gray (color index 35-70), medium to coarse grained, well developed gneissic structure. Generally fresh with well developed patina. Predominant mineralogy consists of potassium feldspar (microcline B-2

and orthoclase), quartz, and plagioclase. Contains locally abundant hornblende, biotite, pyroxene and/or epidote. Numerous intrusions of pegmatite and aplite dikes composed predominantly of microcline and quartz with accessory garnet and chrysocholla.

Quartz-biotite schist - This rock is distinguished predominantly by its parallel orientation of lamellar mafic minerals (chiefly biotite). Pegmatite and aplite dikes are notably less abundant in the schist than in the gneiss.

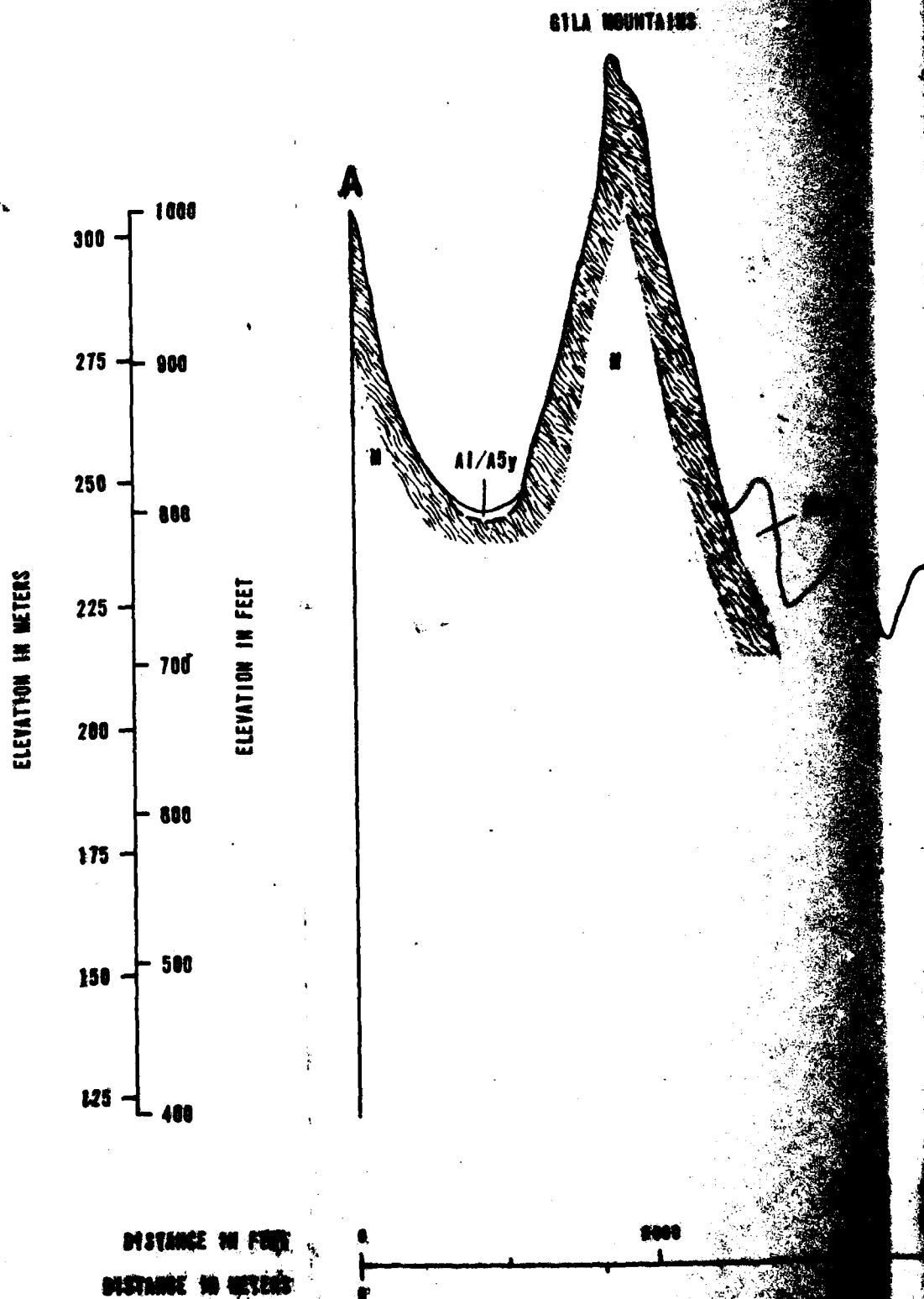
In the Gila Mountains and Wellton Hills, foliation in the metamorphic rock varies greatly due to faulting. However, in the northern Copper Mountains, the strike of the foliation ranges from N65W to NS, and dips from 30 degrees NE to 20 degrees E.

B.1.4 SEDIMENTARY ROCKS (S)

Granite-gneiss boulder conglomerate - Dark gray brown, poorly to non-stratified, subangular to rounded granite, gneiss and quartz monzonite cobbles and boulders in a matrix of light brown to red arkosic sandstone with generally indistinct bedding. Moderately to strongly cemented with silica and/or iron oxide, commonly exhibits cavernous weathering (Tafoni) and imbricate structure of platy cobbles and boulders.

Arkosic sandstone - Clastic texture, grayish brown to reddish brown, fine- to coarse-grained. Typically poorly to well defined bedding consisting mainly of angular to subangular grains with subangular to rounded cobbles and boulders of metamorphic (M) and igneous (I1) rock.

Predominant mineralogy is quartz, potash feldspar, plagioclase, and biotite with accessory magnetite, muscovite, and pyroxene. Biotite and feldspar are largely altered to clay. Calcite and clays are the predominant matrix minerals. Jointing is very poorly developed in the sedimentary rocks.



N 30. E

A5ec

A5ec

SECTION 21
SECTION

18-9-73

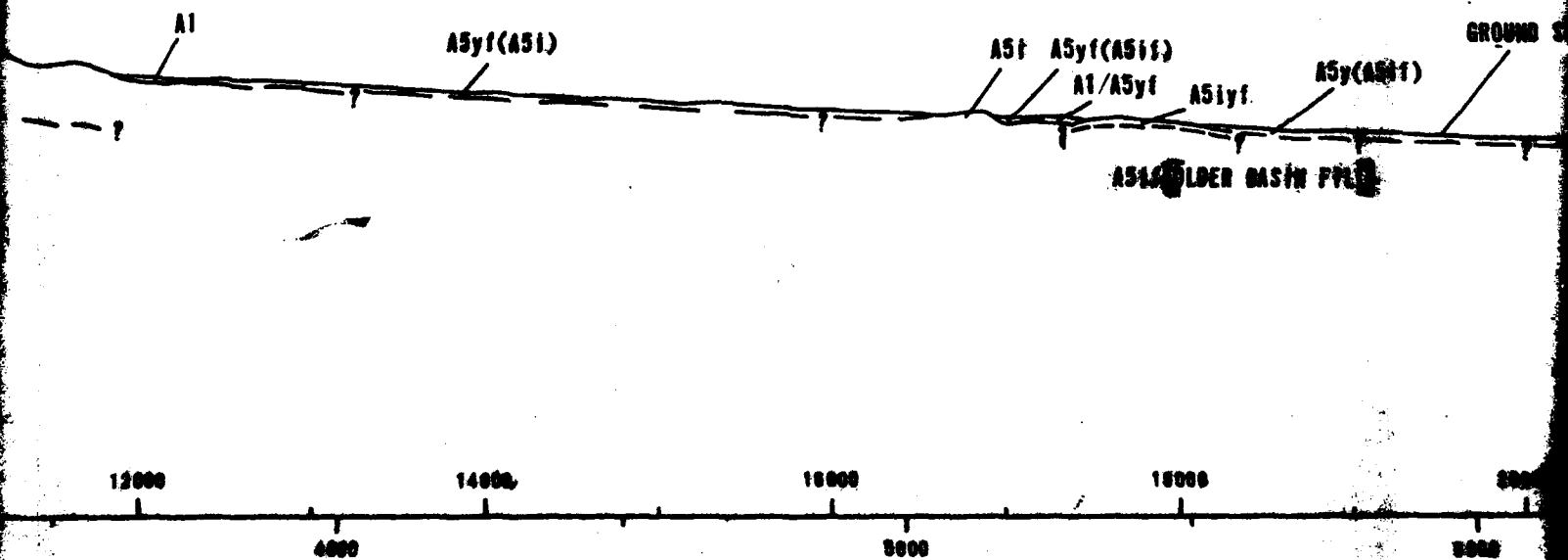
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A5ec ELDER BASIN PM

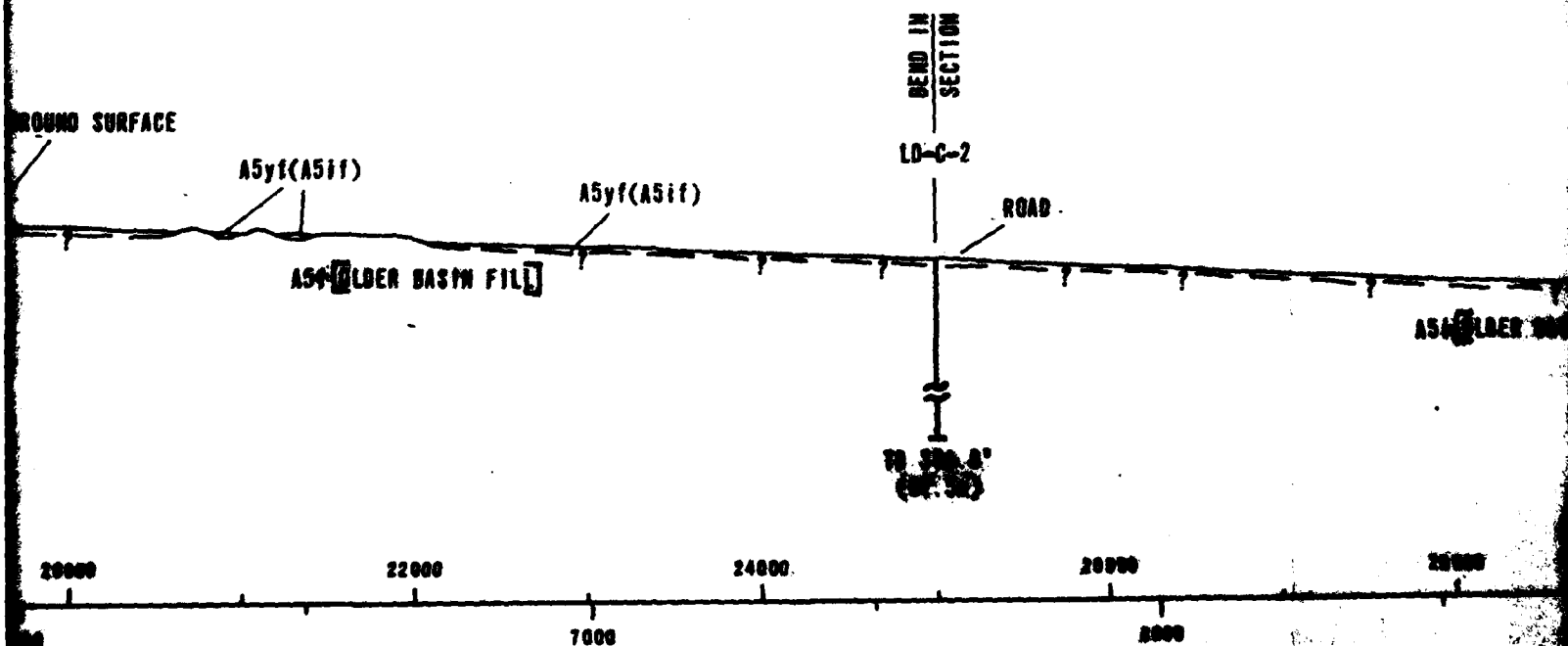
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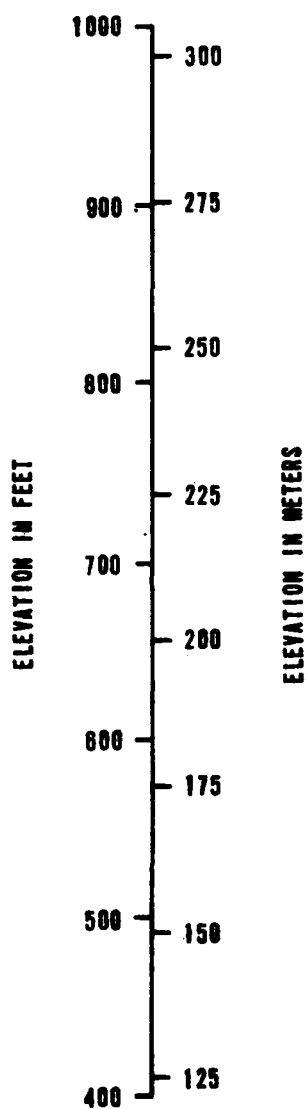
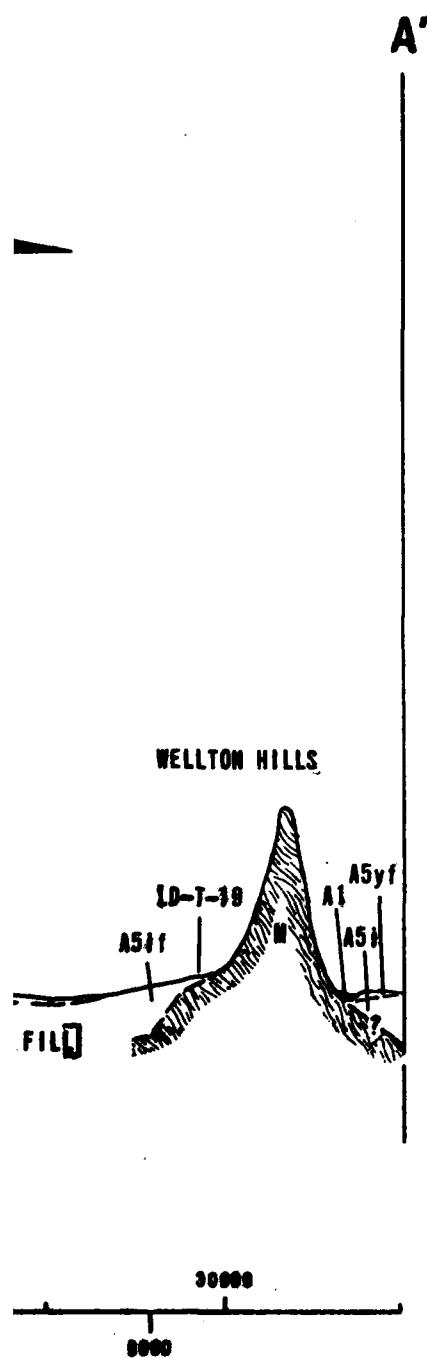
GEOLOGIC CROSS SECTION LD-CS-AA'

N 70 E



N 75 E





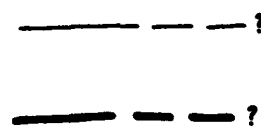
SURFICIAL B

A1	S
A2	T
A3d	E
A3s	E
A5y	Y
A5yf	F
A5iy	I
A5iyf	F
A5iyc	C
A5i	I
A5if	F
A5ic	C
A5oc	C

ROCK UNITS

I1	I
I2	I
M	M
S	S

SYMBOLS



LD-S-1

LD-A, B, C or D-1

LD-T-1



For complete descr

EXPLANATION

ICIAL BASIN-FILL UNITS

- Stream channel deposits
- Terrace deposits
- Eolian sand dune deposits
- Eolian sheet sand deposits
- Younger alluvial fan deposits
- Finer-grained A5y
- Intermediate-younger alluvial fan deposits
- Finer-grained A5iy
- Coarser-grained A5iy
- Intermediate alluvial fan deposits
- Finer-grained A5i
- Coarser-grained A5i
- Coarser-grained older alluvial fan deposits

K UNITS

- Igneous, intrusive
- Igneous, extrusive
- Metamorphic
- Sedimentary

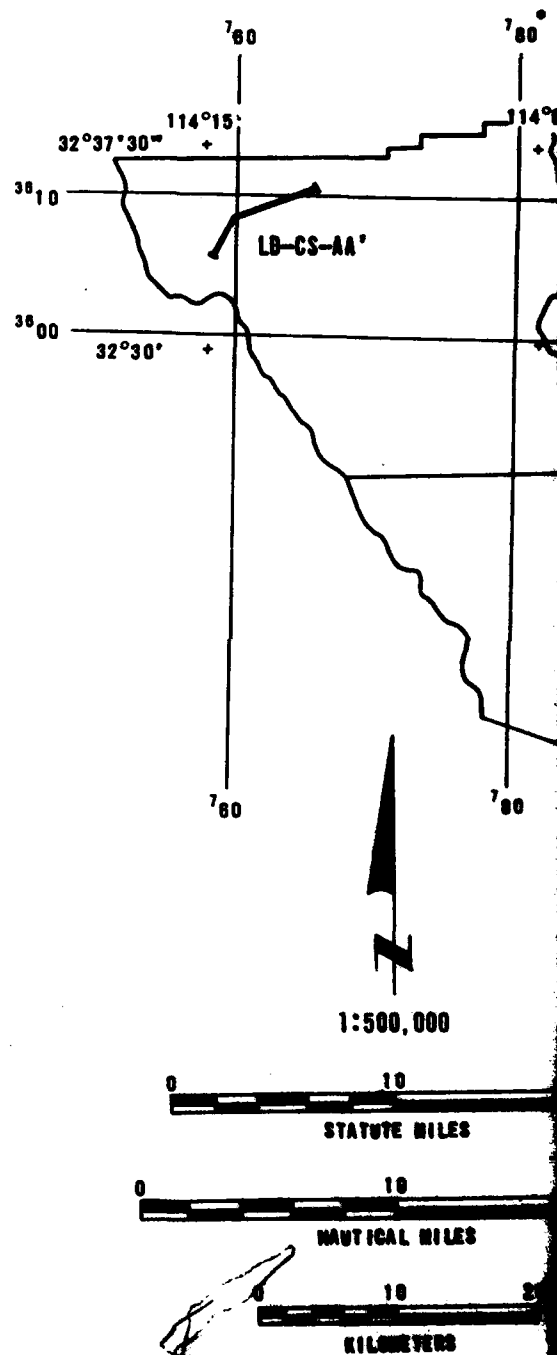
BOLS

- ? Geologic contact; dashed where approximate, queried where extrapolated
- ? Fault; dashed where approximate, queried where extrapolated
- Seismic line (See Appendix A)
- Boring (See Appendix C)
- Trench (See Appendix C)
- Brackets denote underlying unit of unknown depth

description of geologic units, see Drawing 2.

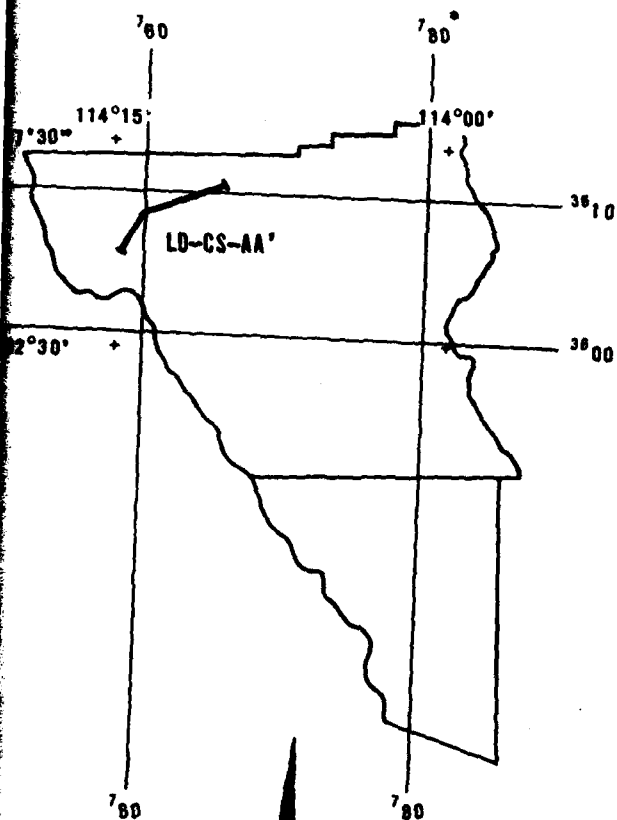
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LOCATION MAP

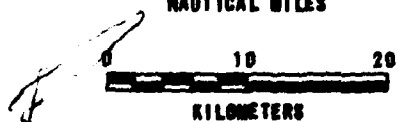


NOTE: See Appendix 2 for details of the geologic units shown on this map.

LOCATION MAP



1:500,000

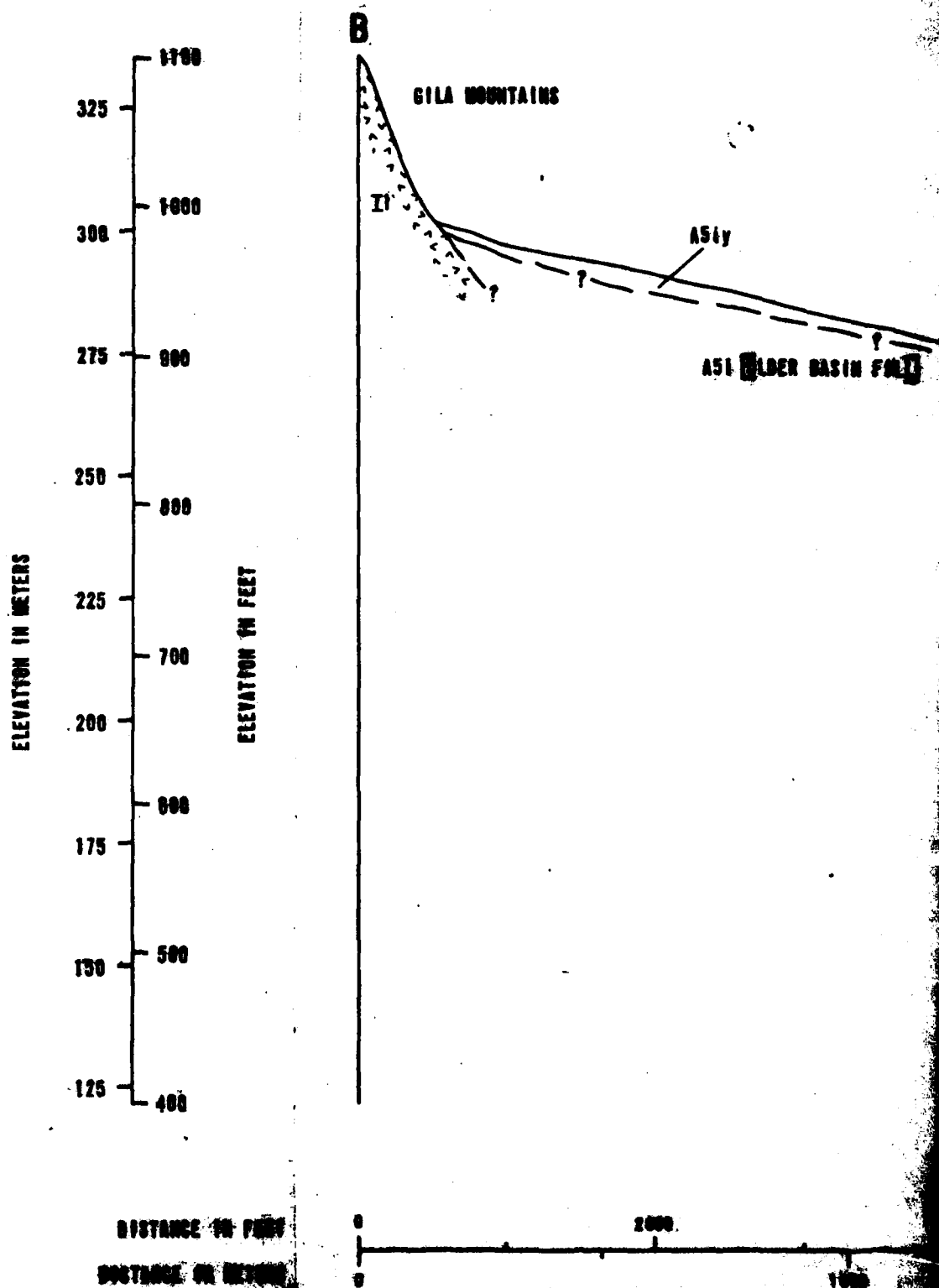


GEOLOGIC CROSS SECTION
LD-CS-AA'
LECHUGUILLA DESERT, ARIZONA

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - SAMS

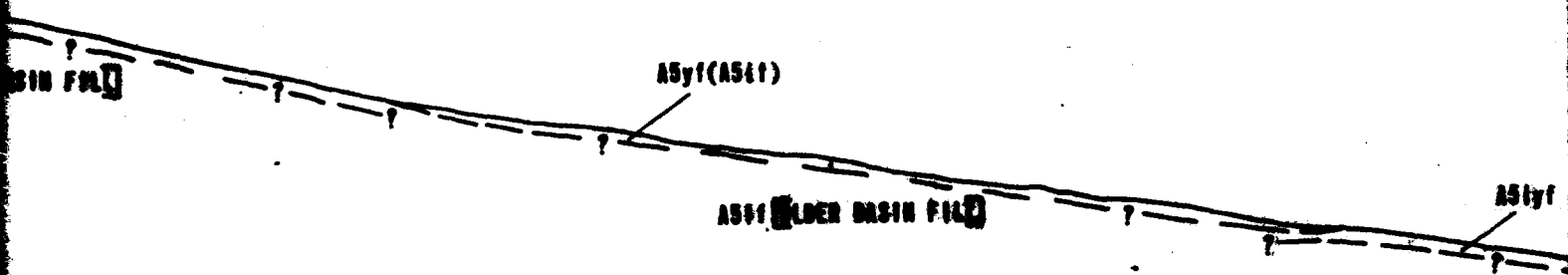
FIGURE
B-1

NOTE: See Appendix page C-5 for explanation of Universal Transverse Mercator Grid System.

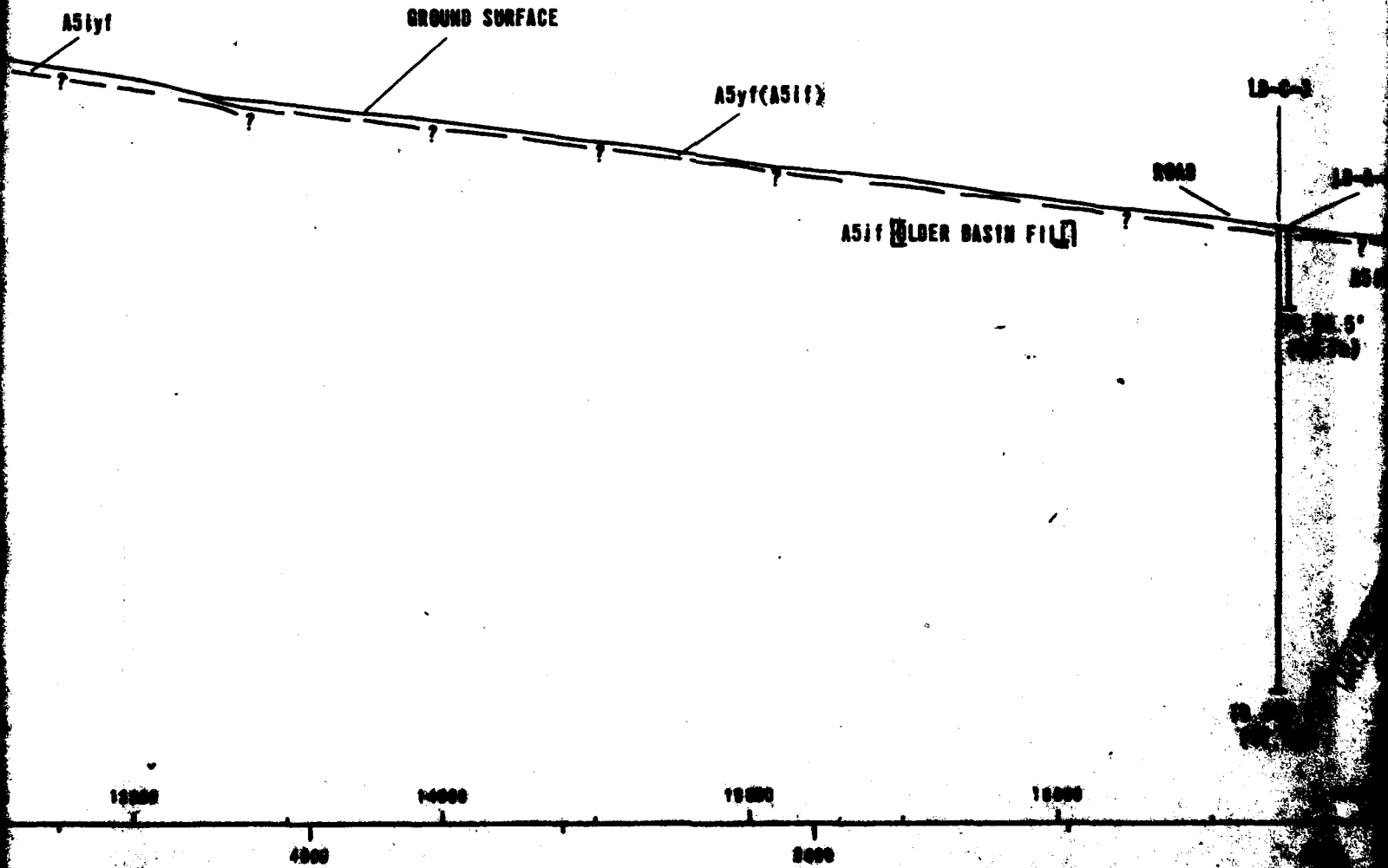


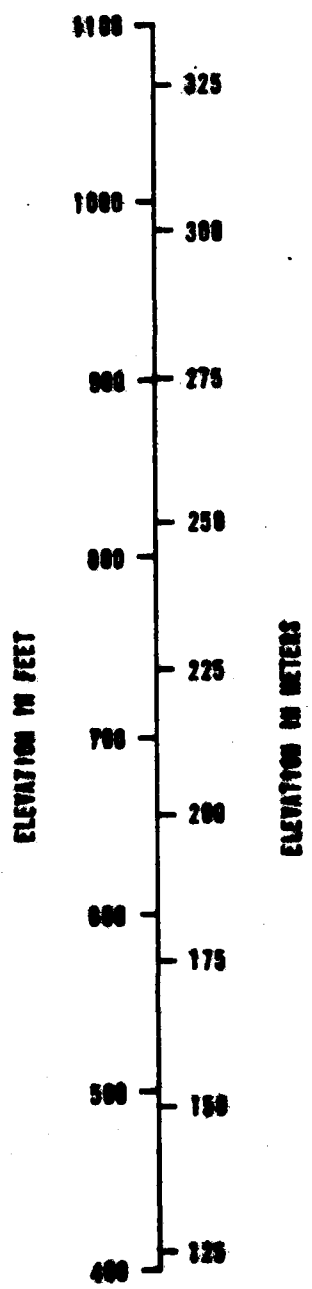
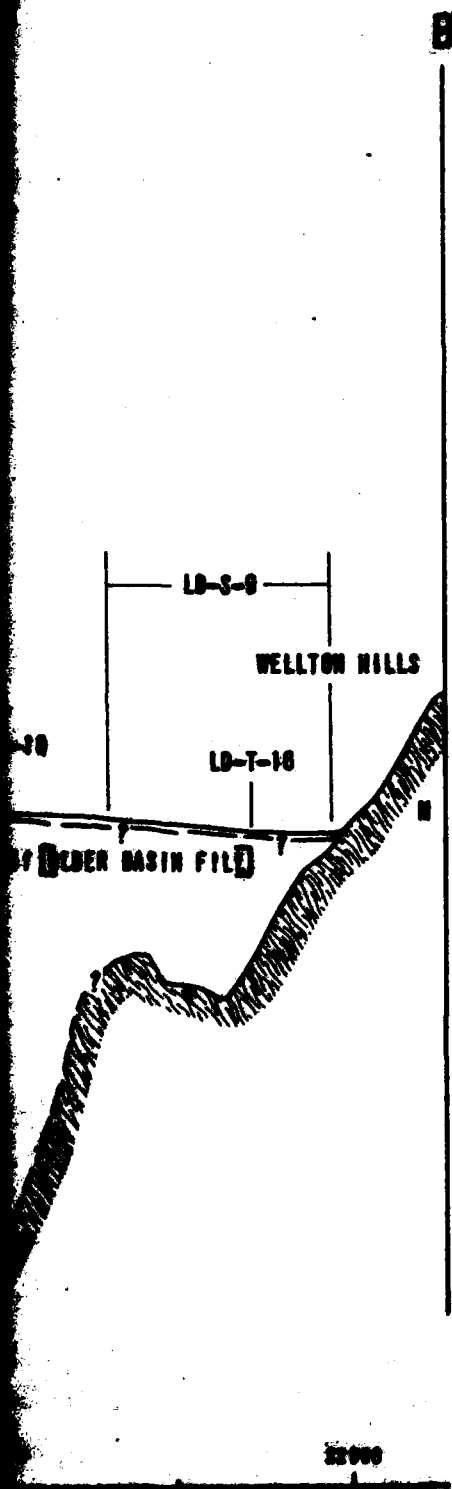
GEOLOGIC CROSS SECTION

N 55 E



SECTION LB-CS-BB





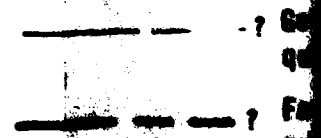
SURFICIAL DATA

AS	St
AS	Ter
ASa	Eol
ASc	Eol
ASy	Yol
ASyf	Fl
ASiy	Int
ASiyf	Fl
ASiye	Co
ASi	Int
ASif	Fl
ASic	Co
ASec	Co

ROCK UNITS

X1	10
X2	10
H	10
S	10

SYMBOLS



LD-S-1

LD-A, B, C or D-1

LD-T-1

[]

For ...

EXPLANATION

ALLUVIAL BASIN-FILL UNITS

- Stream channel deposits
- Terrace deposits
- Eolian sand dune deposits
- Eolian sheet sand deposits
- Younger alluvial fan deposits
- Finer-grained A5y
- Intermediate-younger alluvial fan deposits
- Finer-grained A5iy
- Coarser-grained A5iy
- Intermediate alluvial fan deposits
- Finer-grained A5i
- Coarser-grained A5i
- Coarser-grained older alluvial fan deposits

UNITS

- Igneous, intrusive
- Igneous, extrusive
- Metamorphic
- Sedimentary

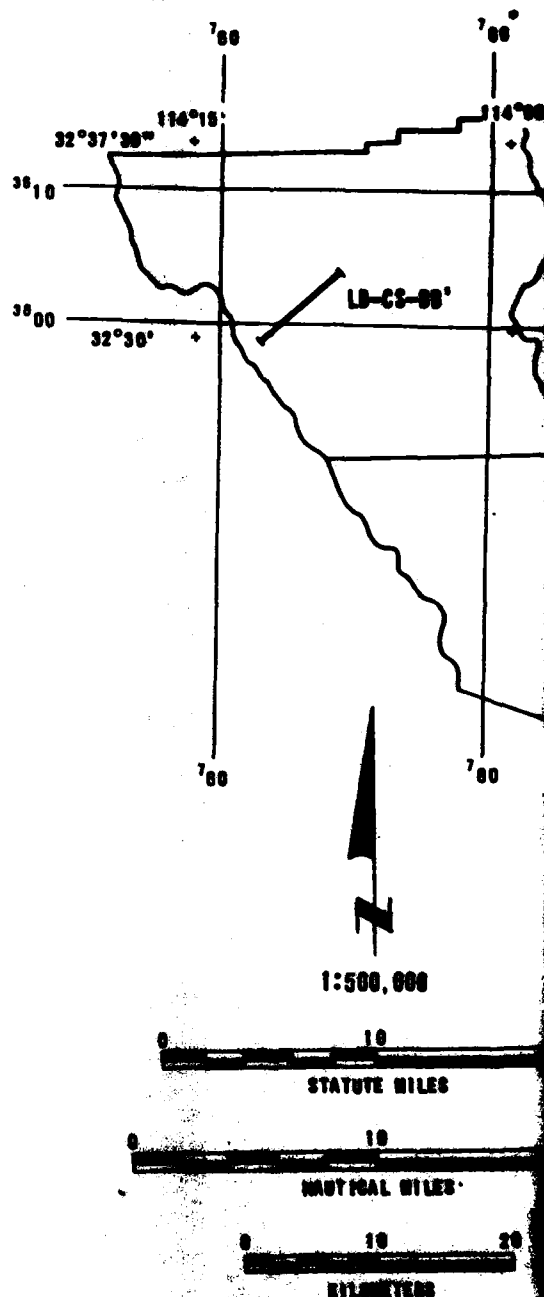
SYMBOLS

- ? Geologic contact; dashed where approximate, queried where extrapolated
- ? Fault; dashed where approximate, queried where extrapolated
- Seismic line (See Appendix A)
- Doring (See Appendix C)
- Trench (See Appendix C)
- Brackets denote underlying unit of unknown depth

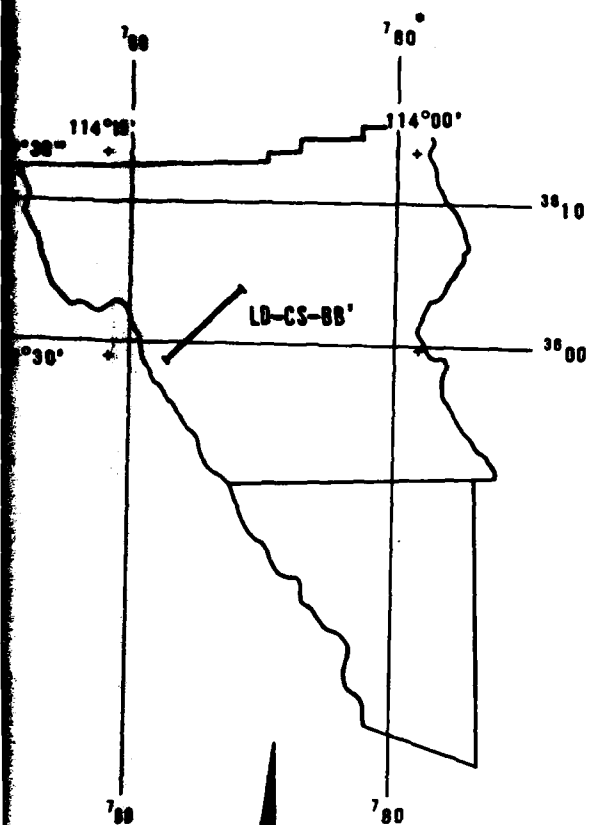
Description of geologic units, see Drawing 2.

VERTICAL EXAGGERATION: 10X

LOCATION MAP



LOCATION MAP



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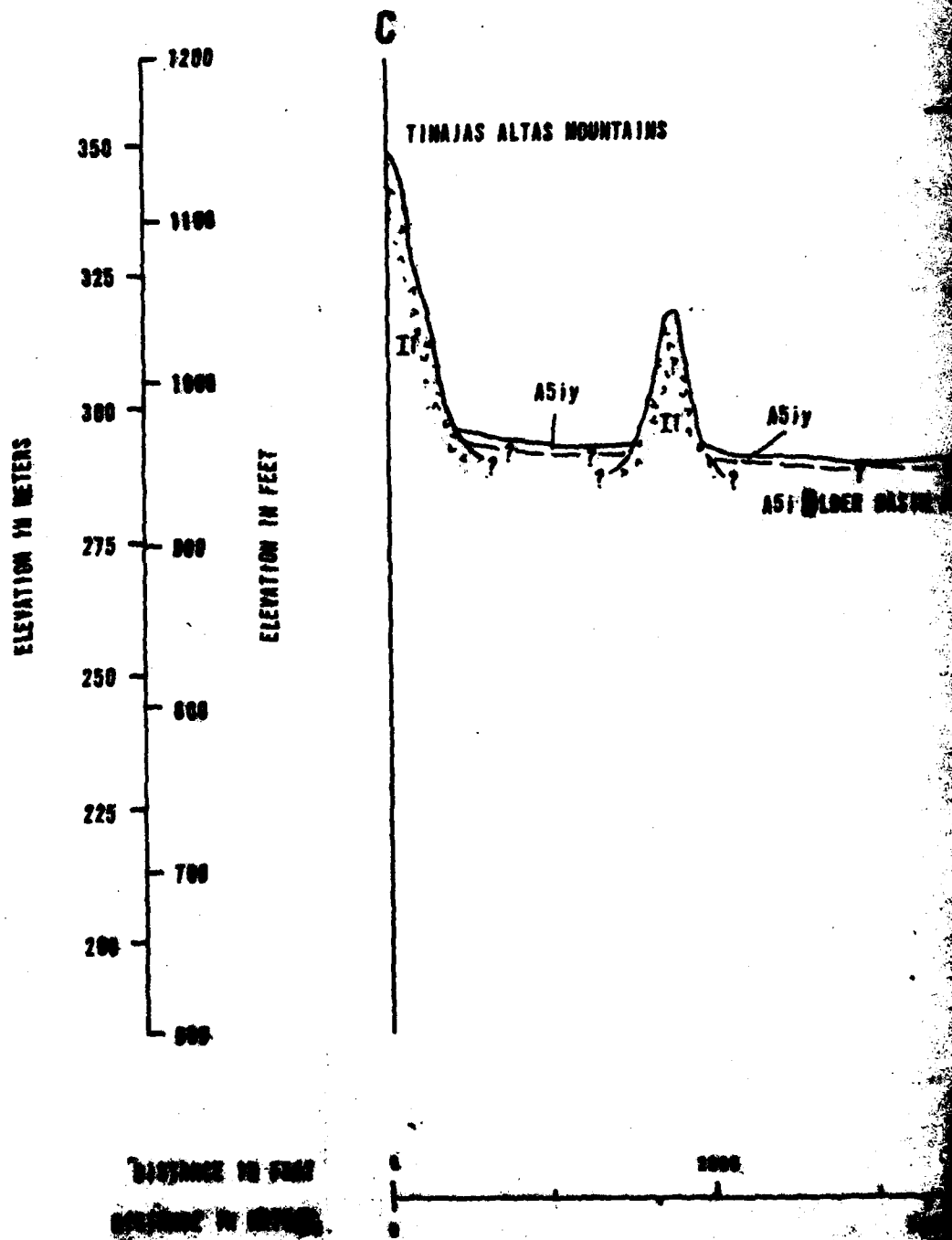


GEOLOGIC CROSS SECTION
LD-CS-88'
LECHUGUILLA DESERT, ARIZONA

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - SAGE

FIGURE
2-1

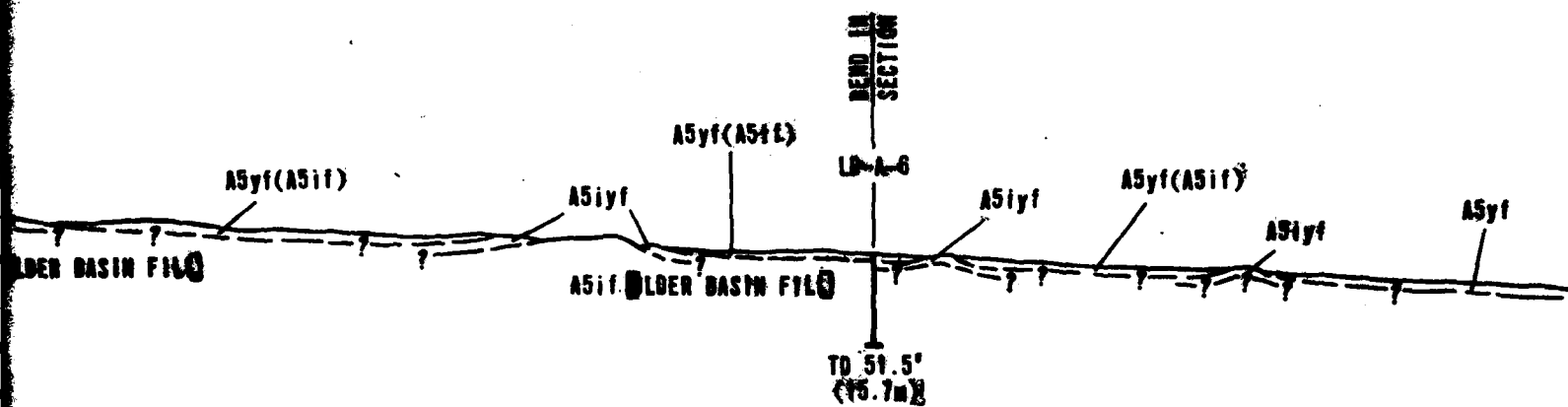
See Appendix page 6-8 for explanation Universal
Transverse Mercator Grid System.



GEOLOGIC CROSS SECTION LD-86-0C

DUE E

S 8



S 80 E

GROUND SURFACE

ROAD

A5if: OLDER BASIN FIL

A5iyf

A5yf

A5iyf

A5yf(A5if)

LD-C-4

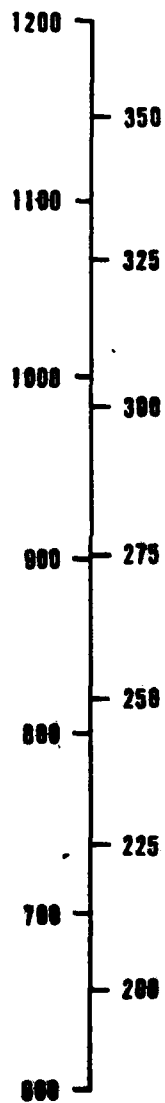
ROAD

CABEZA PRIETA BOUNDARY

C

ELEVATION IN FEET

ELEVATION IN METERS



TO 300.5'
(91.4m)

00000

10000

20000

3000

4000

EXPLANATION

SURFICIAL BASIN-FILL UNITS

A1	Stream channel deposits
A2	Terrace deposits
A3d	Eolian sand dune deposits
A3s	Eolian sheet sand deposits
A5y	Younger alluvial fan deposits
A5yf	Finer-grained A5y
A5iy	Intermediate-younger alluvial fan deposits
A5iyf	Finer-grained A5iy
A5iyc	Coarser-grained A5iy
A5i	Intermediate alluvial fan deposits
A5if	Finer-grained A5i
A5ic	Coarser-grained A5i
A5oc	Coarser-grained older alluvial fan deposits

ROCK UNITS

I1	Igneous, intrusive
I2	Igneous, extrusive
M	Metamorphic
S	Sedimentary

SYMBOLS

—— — — ? Geologic contact; dashed where approximate, queried where extrapolated

—— — — ? Fault; dashed where approximate, queried where extrapolated

LD-S-1 Seismic line (See Appendix A)

LD-A, B, C or D-1 Boring (See Appendix C)

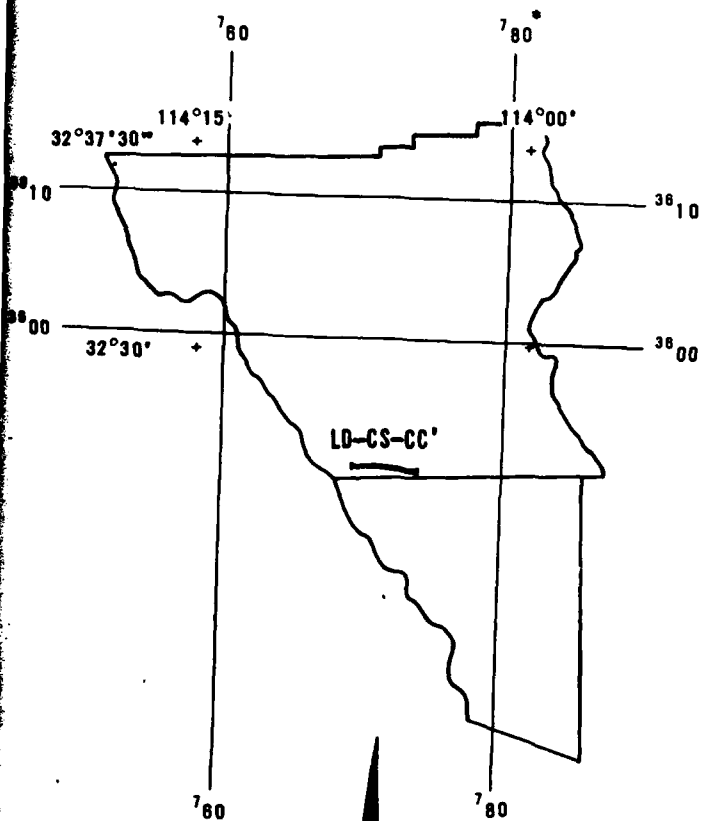
LD-T-1 Trench (See Appendix C)

[] Brackets denote underlying unit of unknown depth

For complete description of geologic units, see Drawing 2.

VERTICAL EXAGGERATION: 10X

LOCATION MAP



0 10 20
STATUTE MILES

0 10 20
NAUTICAL MILES

0 10 20
KILOMETERS

*NOTE: See Appendix page C-5 for explanation of Universal Transverse Mercator Grid System.

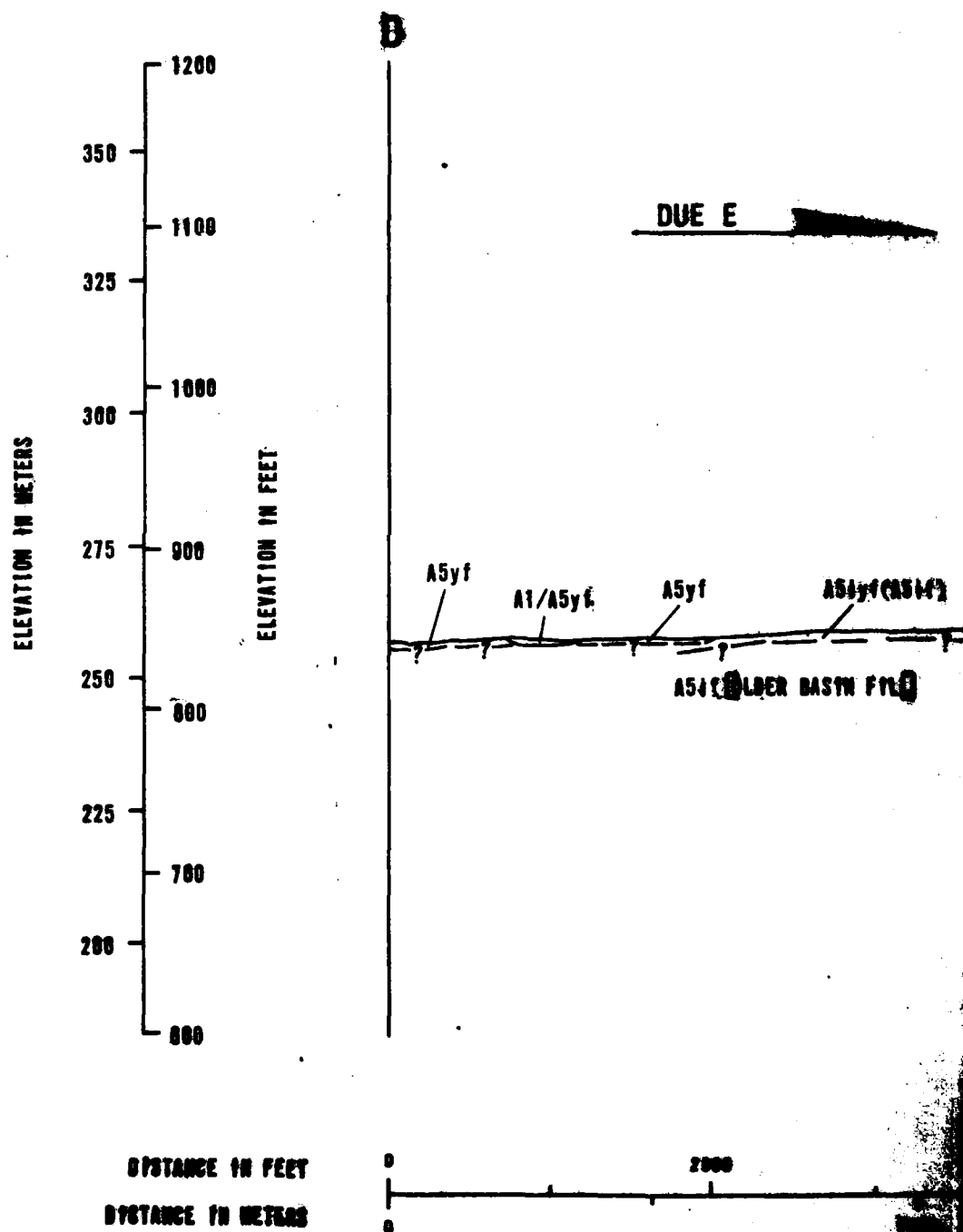
GEOLOGIC CROSS SECTION
LD-CS-CC'
LECHUGUILLA DESERT, ARIZONA

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - SANSD

FIGURE 5

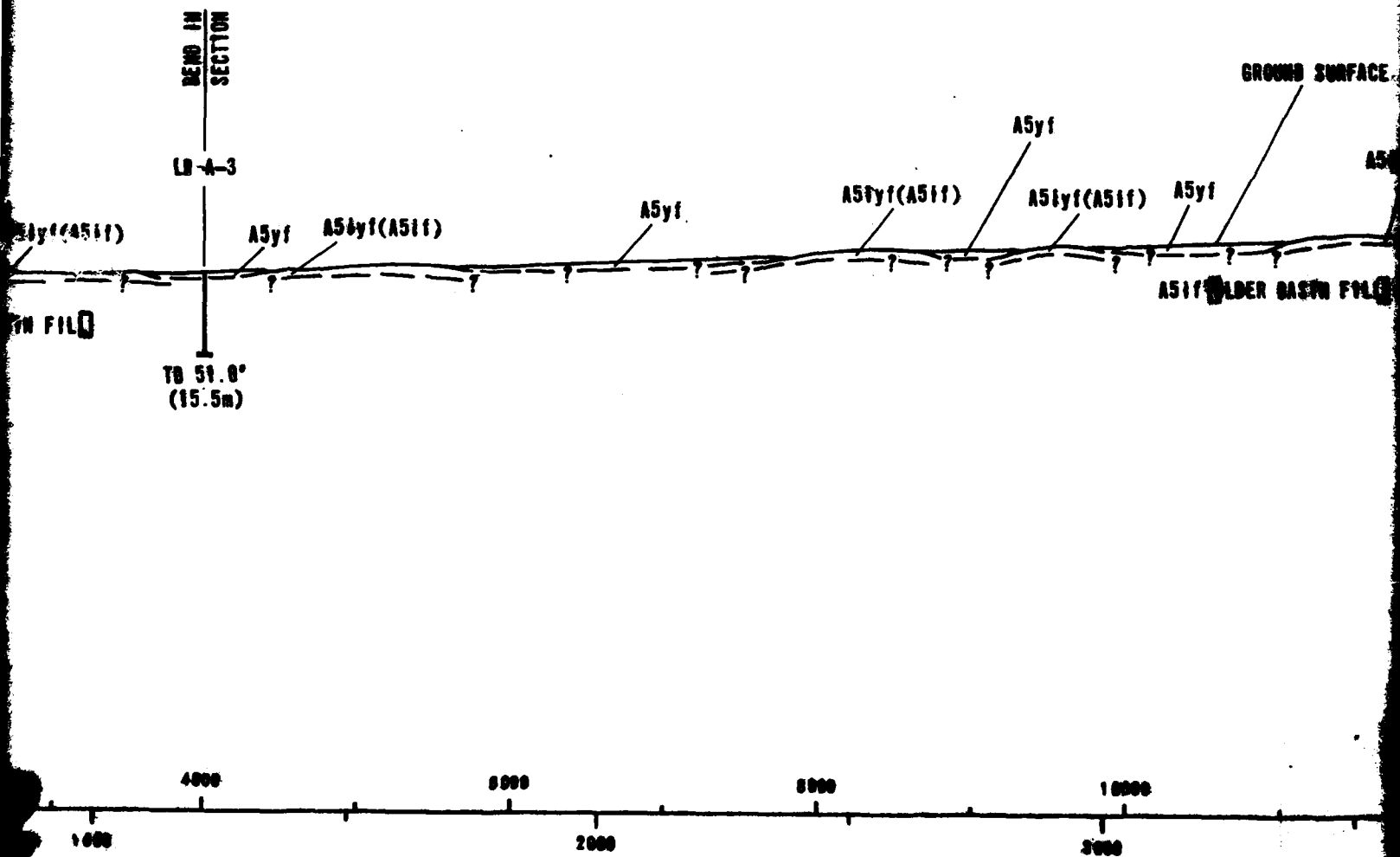
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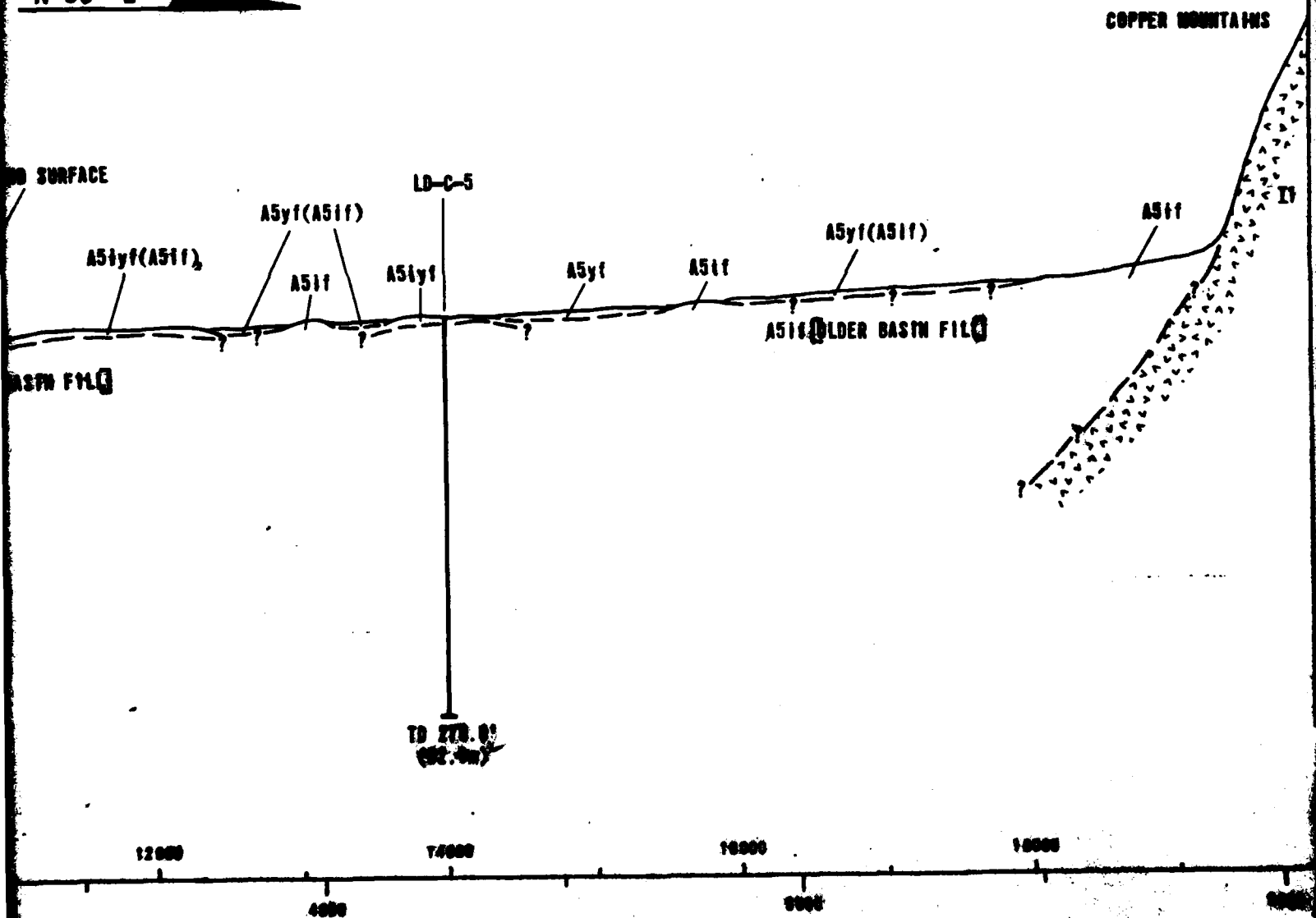
GEOLOGIC CROSS SECTION LO-C

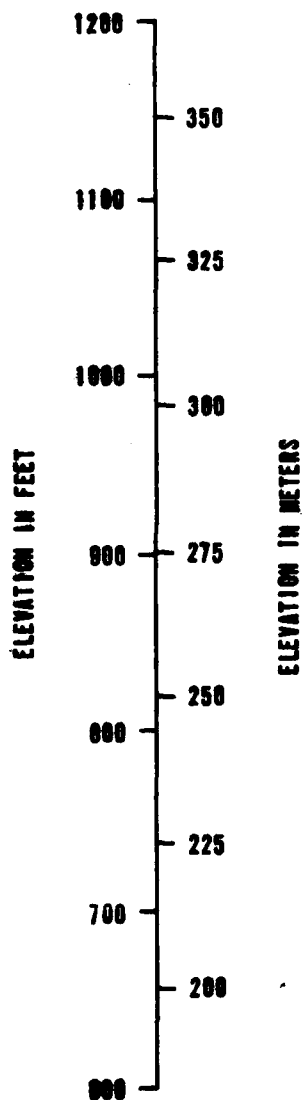
N 89



ED-CS-DD

N 80 E





EXPLANATION

SURFICIAL BASIN-FILL UNITS

A1	Stream channel deposits
A2	Terrace deposits
A3d	Eolian sand dune deposits
A3s	Eolian sheet sand deposits
A5y	Younger alluvial fan deposits
A5yf	Finer-grained A5y
A5iy	Intermediate-younger alluvial
A5iyf	Finer-grained A5iy
A5iyc	Coarser-grained A5iy
A5i	Intermediate alluvial fan depos
A5if	Finer-grained A5i
A5ic	Coarser-grained A5i
A5oc	Coarser-grained older alluvial

ROCK UNITS

I1	Igneous, intrusive
I2	Igneous, extrusive
M	Metamorphic
S	Sedimentary

SYMBOLS

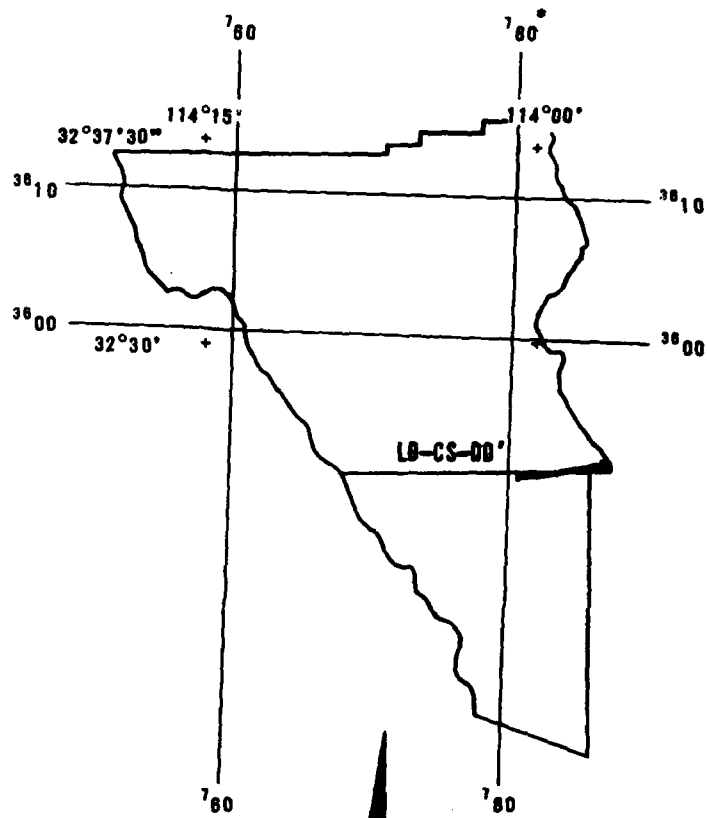
— — — ?	Geologic contact; dashed where queried where extrapolated
— — — ?	Fault; dashed where approximated queried where extrapolated

LD-S-1	Seismic line (See Appendix A)
LD-A, B, C or D-1	Boring (See Appendix C)
LD-T-1	Trench (See Appendix C)
[]	Brackets denote underlying

For complete description of geologic units, see

VERTICAL EXAGGERATION: 10X

LOCATION MAP



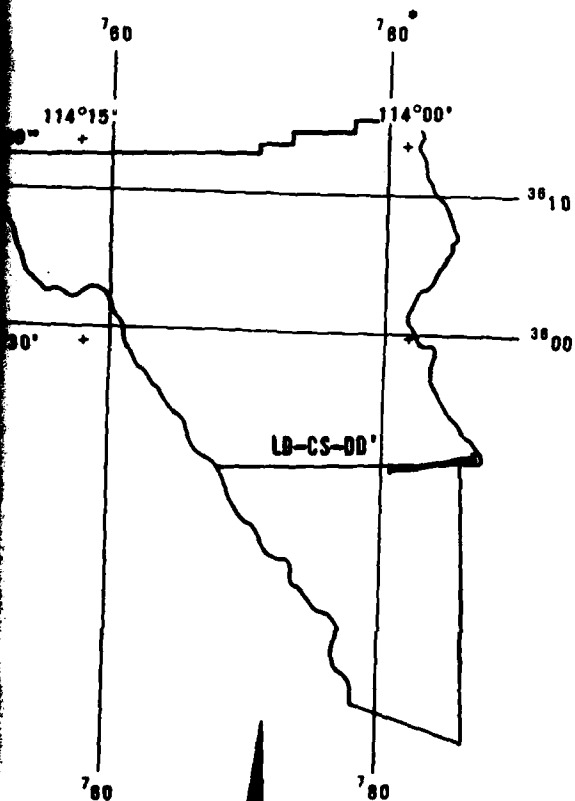
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NOTE: See Appendix page G-3 for explanation Universal Transverse Mercator Grid System.

5

LOCATION MAP



1:500,000



STATUTE MILES



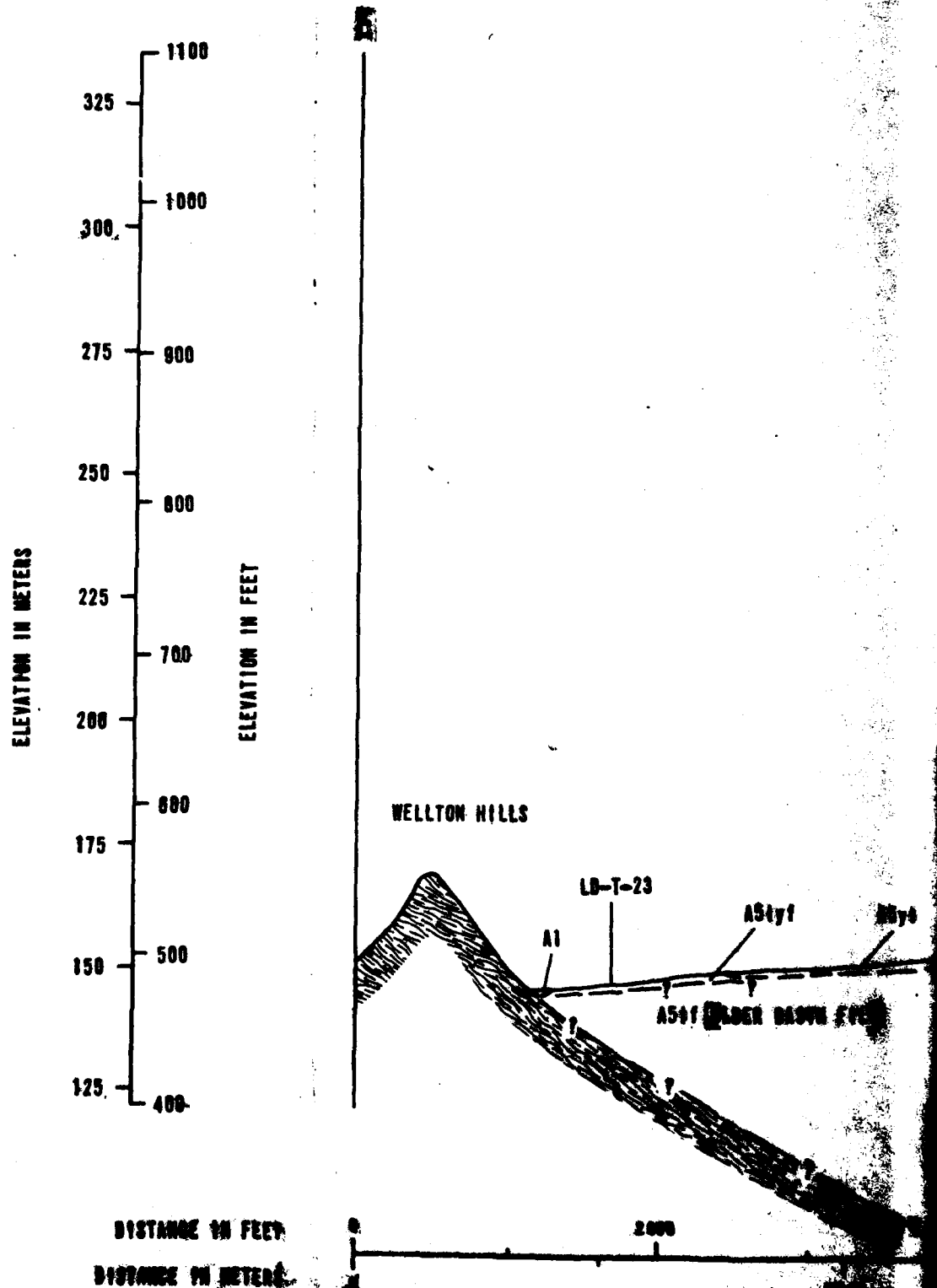
NAUTICAL MILES

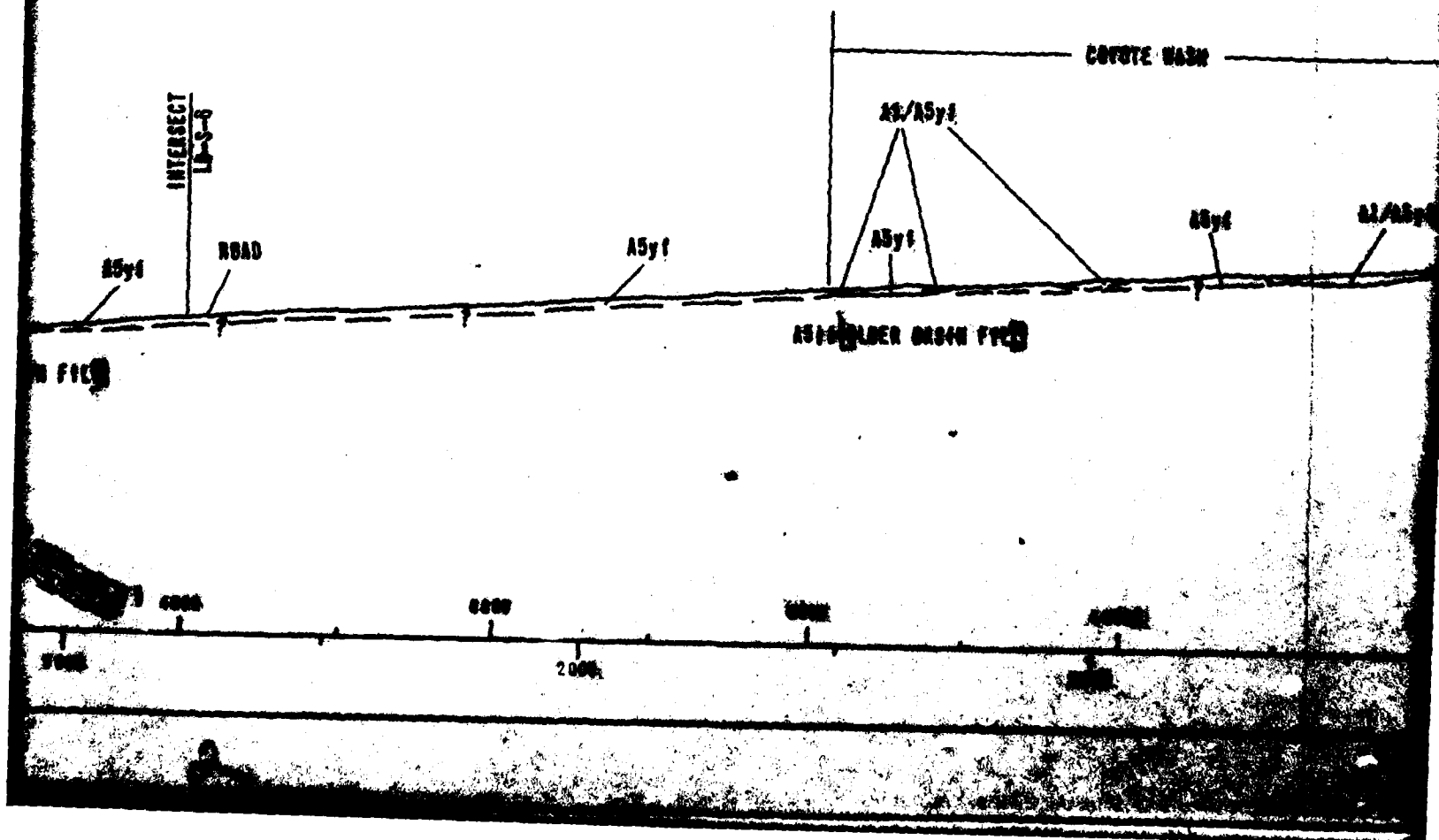


KILOMETERS

GEOLOGIC CROSS SECTION LB-CS-00' LECHUGUILLA DESERT, ARIZONA	
MX SITING INVESTIGATION DEPARTMENT OF THE AIR FORCE - SANSO	FIGURE 8-4

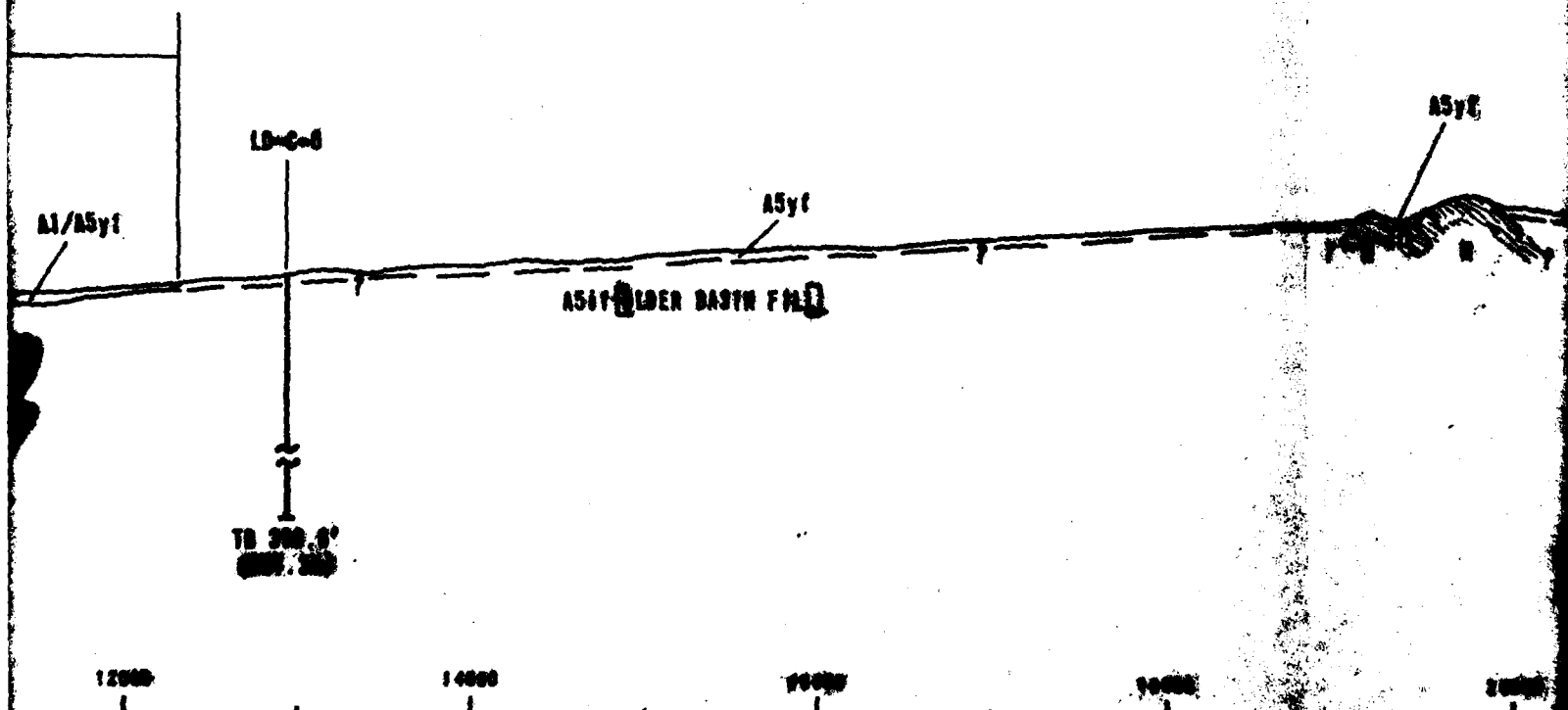
See Appendix page C-5 for explanation Universal Transverse Mercator Grid System.





GEOLOGIC CROSS SECTION LD-27-02

S 50 E



GROUND SURFACE

A5yf

A511 (ELDER BASIN FIL)

A511 (ELDER BASIN)

22000

24000

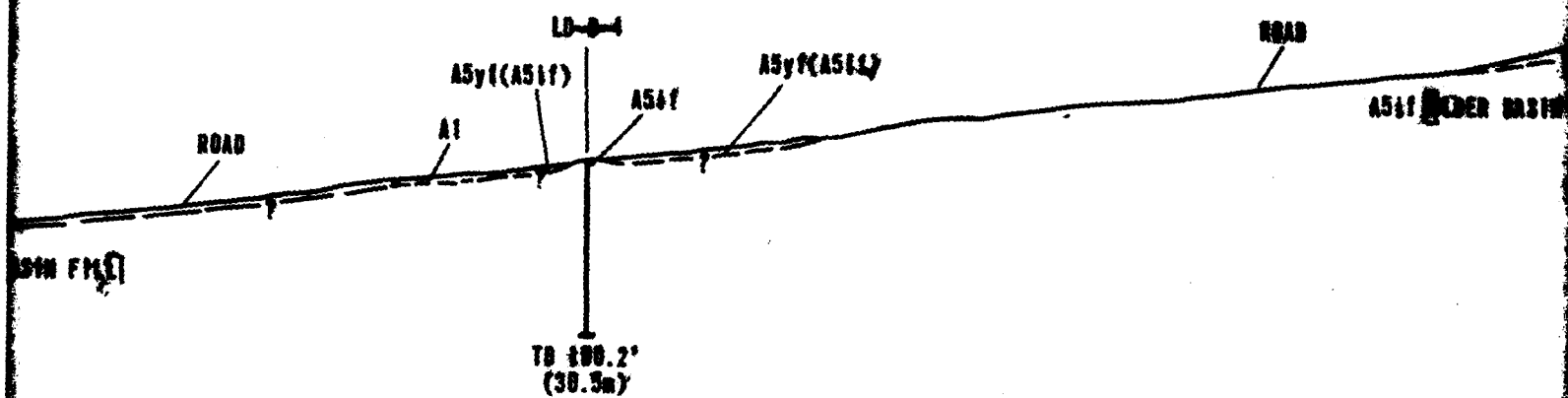
7000

23000

7000

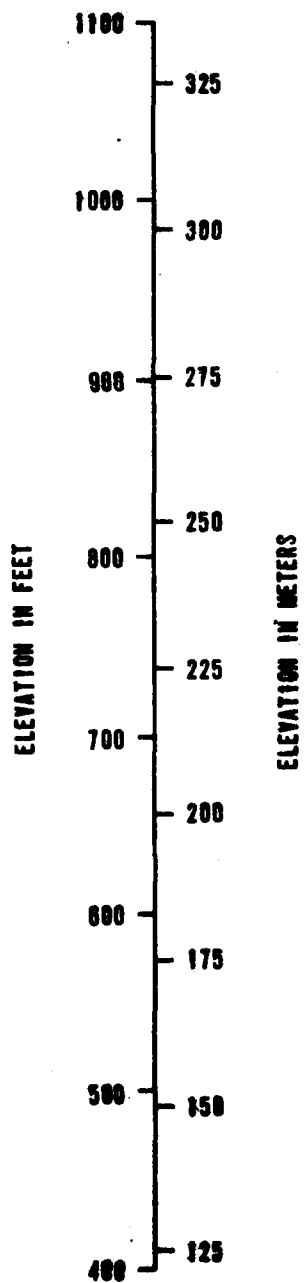
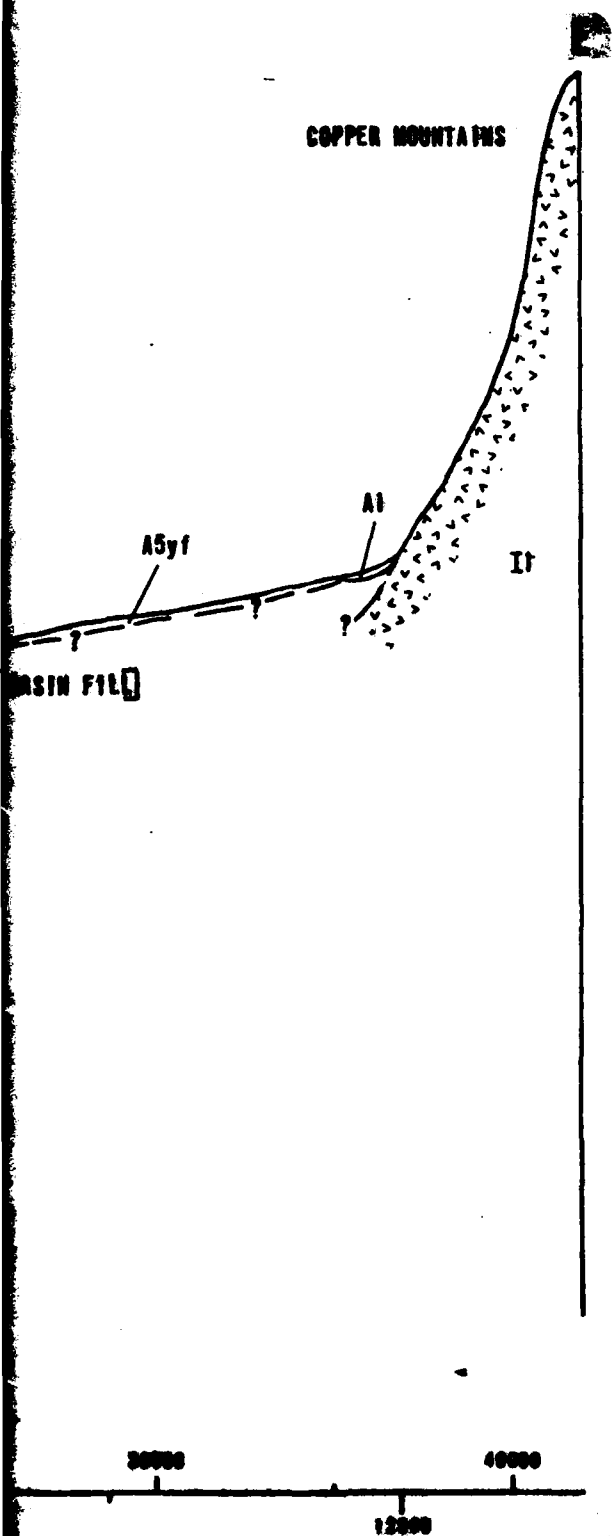
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4



30000 32000 34000 36000

30000 32000 34000 36000



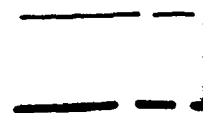
SURFICIAL

A1
A2
A3d
A3s
A5y
A5yf
A5iy
A5iyf
A5iyc
A5i
A5if
A5ic
A5oc

ROCK

I1
I2
N
S

SYMBOLS



LD-S-1

LD-A, B, C or D-1

LD-T-1



For complete

EXPLANATION

SURFICIAL BASIN-FILL UNITS

A1	Stream channel deposits
A2	Terrace deposits
A3d	Eolian sand dune deposits
A3s	Eolian sheet sand deposits
A5y	Younger alluvial fan deposits
A5yf	Finer-grained A5y
A5iy	Intermediate-younger alluvial fan deposits
A5iyf	Finer-grained A5iy
A5iyc	Coarser-grained A5iy
A5i	Intermediate alluvial fan deposits
A5if	Finer-grained A5i
A5ic	Coarser-grained A5i
A5oc	Coarser-grained older alluvial fan deposits

ROCK UNITS

I1	Igneous, intrusive
I2	Igneous, extrusive
M	Metamorphic
S	Sedimentary

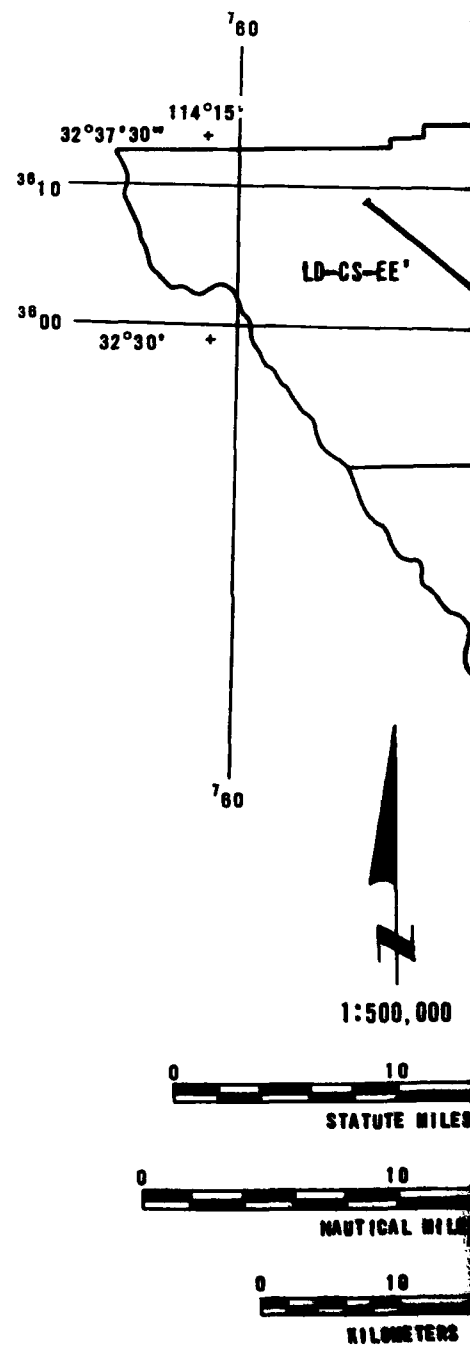
SYMBOLS

— — — ?	Geologic contact; dashed where approximate, queried where extrapolated
— — — ?	Fault; dashed where approximate, queried where extrapolated
LD-S-1	Seismic line (See Appendix A)
or D-1	Boring (See Appendix C)
LD-T-1	Trench (See Appendix C)
[]	Brackets denote underlying unit of unknown depth

Complete description of geologic units, see Drawing 2.

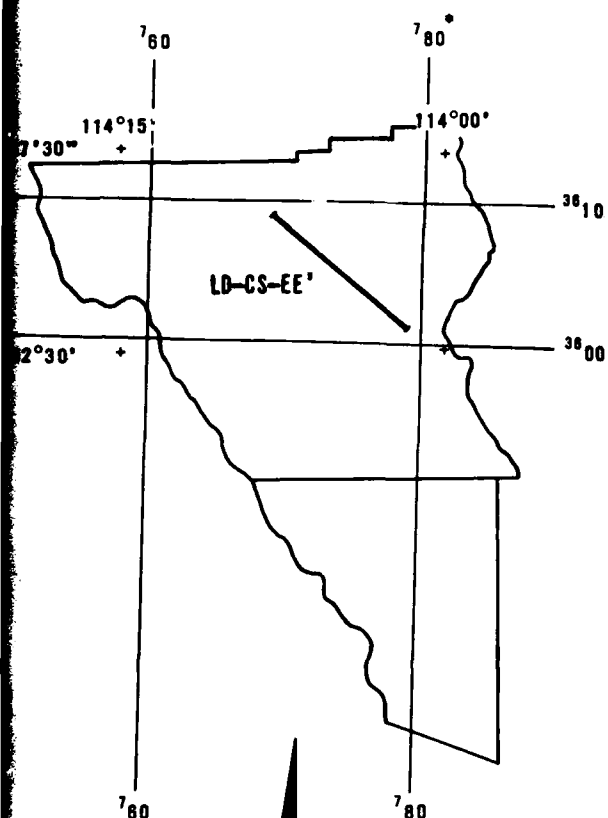
VERTICAL EXAGGERATION: 10X

LOCATION MAP



NOTE: See Appendix page C-5 for a Transverse Mercator Grid Map

LOCATION MAP



1:500,000



STATUTE MILES



NAUTICAL MILES



KILOMETERS

GEOLOGIC CROSS SECTION
LD-CS-EE'
LECHUGUILLA DESERT, ARIZONA

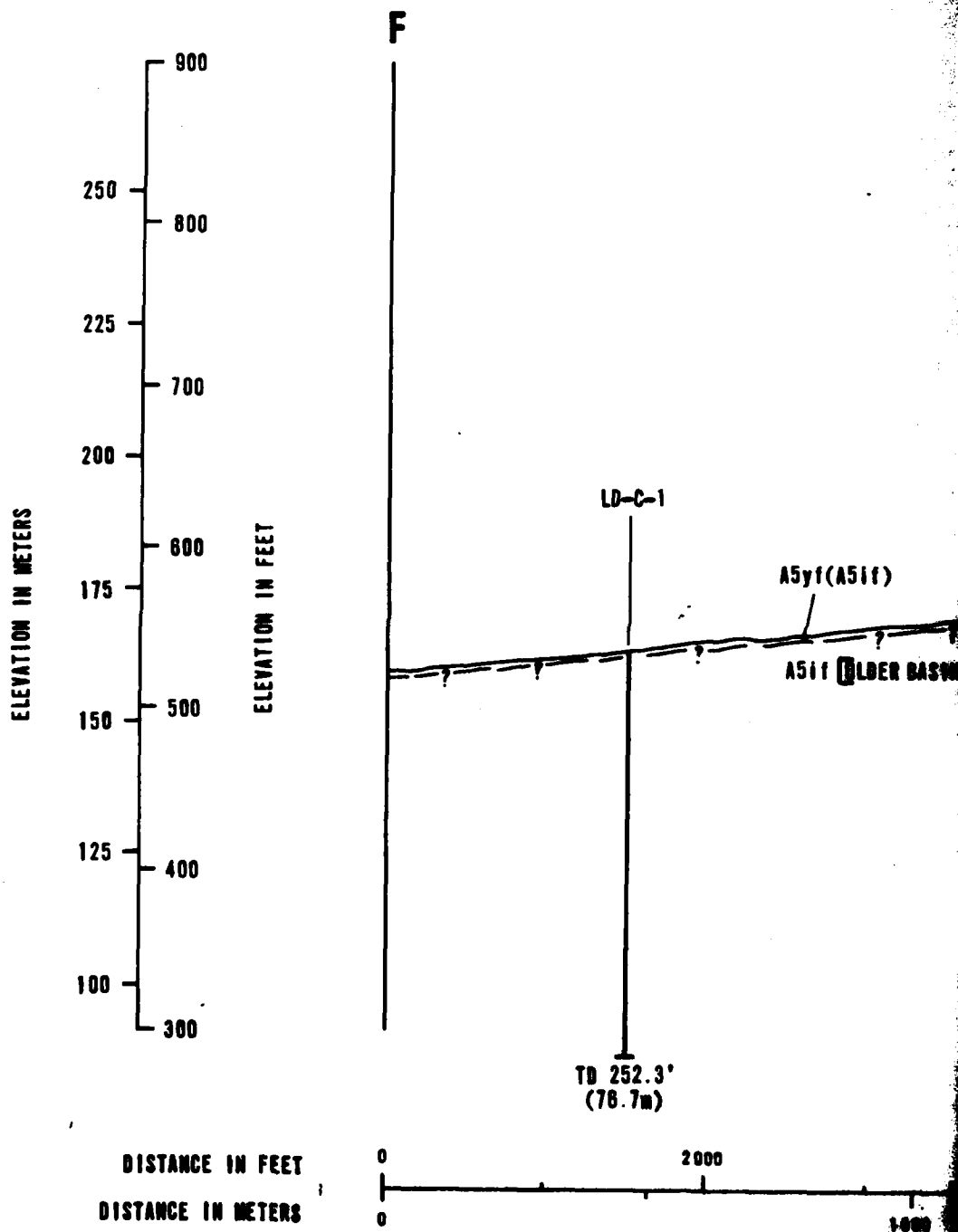
MX SITING INVESTIGATION
 DEPARTMENT OF THE AIR FORCE - SANSO

FIGURE
B-5

FURBER NATIONAL, INC.

See Appendix page C-5 for explanation of Universal Transverse Mercator Grid System.

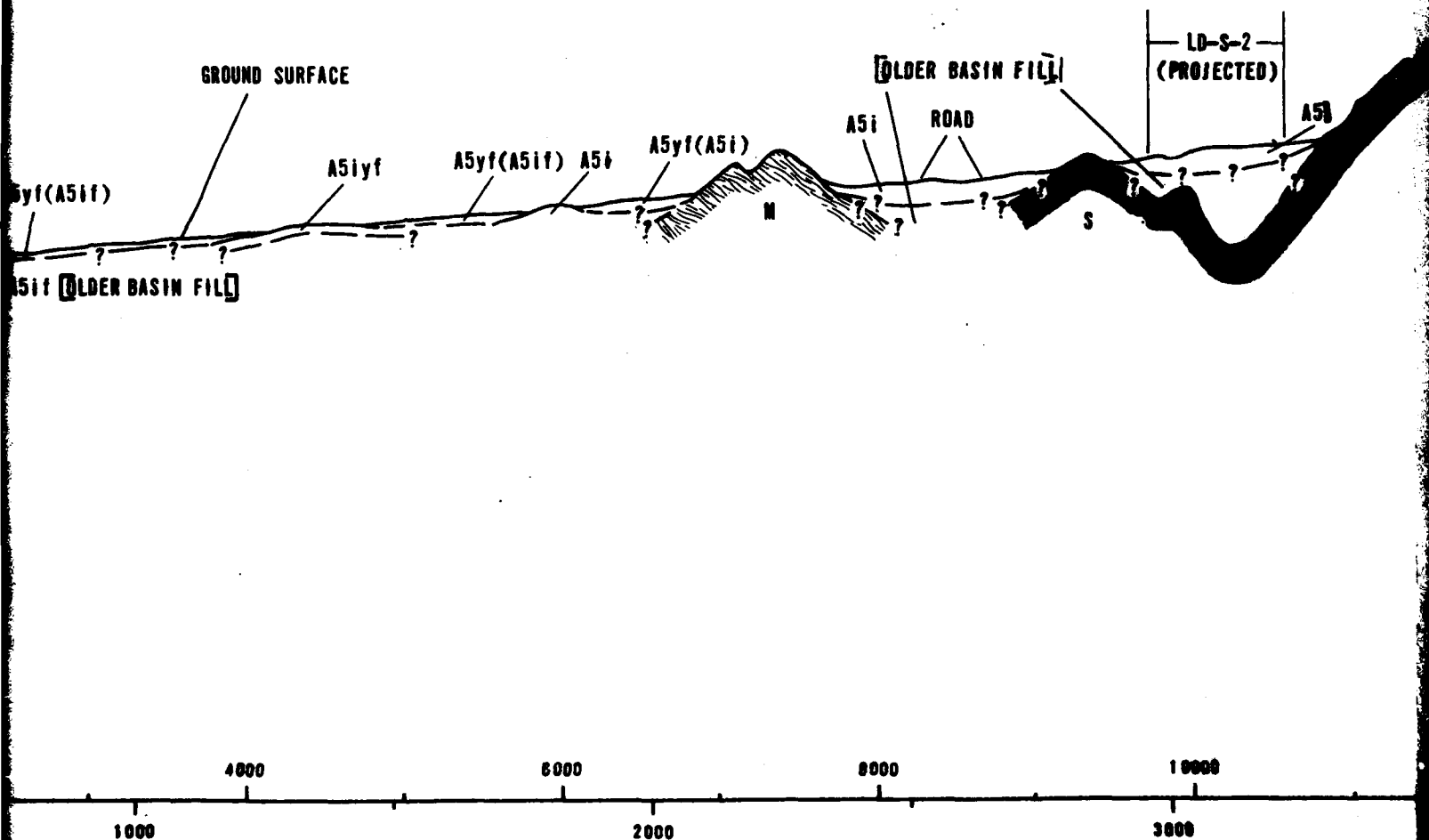
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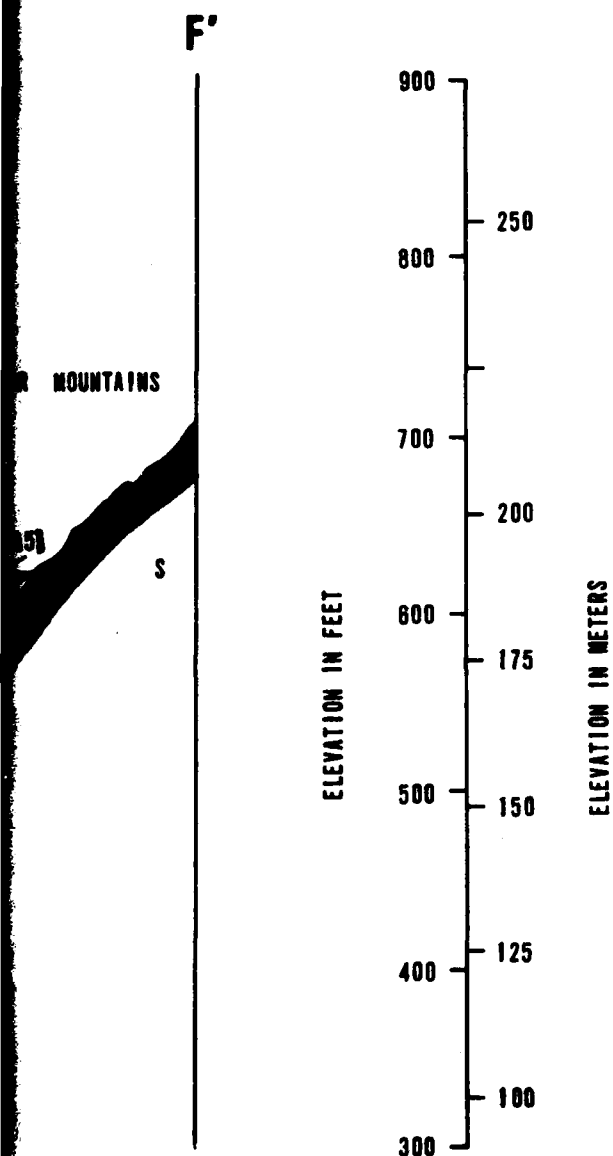


GEOLOGIC CROSS SECTION LD-CS-FF'

S 45 E

COPPER MOUNTAIN





EXPLANATION

SURFICIAL BASIN-FILL UNITS

A1	Stream channel deposits
A2	Terrace deposits
A3d	Eolian sand dune deposits
A3s	Eolian sheet sand deposits
A5y	Younger alluvial fan
A5yf	Finer-grained A5y
A5iy	Intermediate-younger
A5iyf	Finer-grained A5iy
A5iyc	Coarser-grained A5iy
A5i	Intermediate alluvial
A5if	Finer-grained A5i
A5ic	Coarser-grained A5i
A5oc	Coarser-grained older

ROCK UNITS

I1	Igneous, intrusive
I2	Igneous, extrusive
M	Metamorphic
S	Sedimentary

SYMBOLS

— — — ?	Geologic contact; dashed where queried where extrapolated
— — — ?	Fault; dashed where queried where extrapolated

LD-S-1 Seismic line (See Appendix)

LD-A, B, C or D-1 Boring (See Appendix)

LD-T-1 Trench (See Appendix)

[] Brackets denote underground

For complete description of geologic units

VERTICAL EXAGGERATION

ANATION

UNITS

anel deposits

osits

dune deposits

at sand deposits

uvial fan deposits

ed A5y

re-younger alluvial fan deposits

ed A5iy

ained A5iy

re alluvial fan deposits

ed A5i

ained A5i

ained older alluvial fan deposits

intrusive

xtrusive

ic

y

ontact; dashed where approximate,

ore extrapolated

ed where approximate,

ore extrapolated

ne (See Appendix A)

e Appendix C)

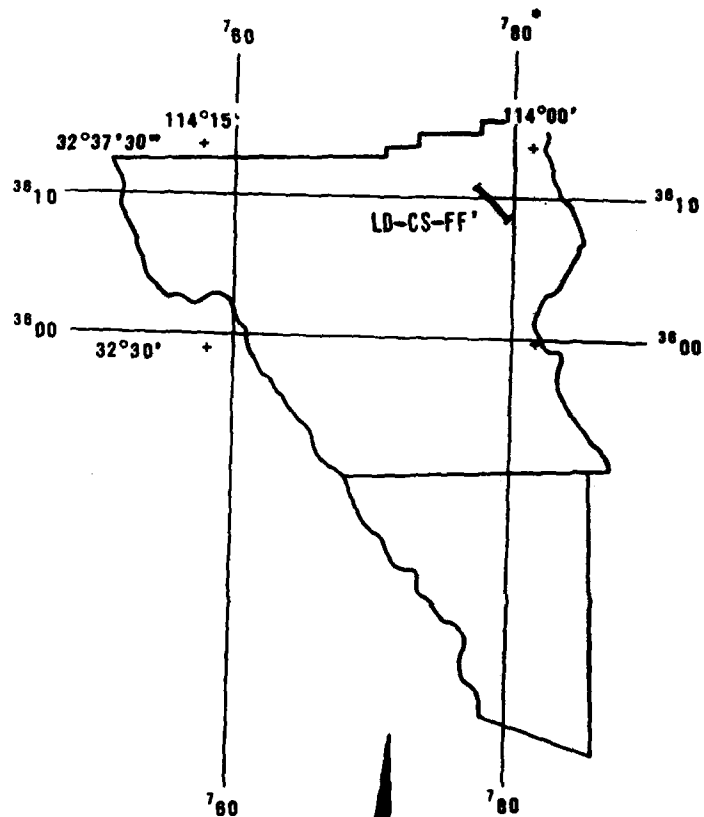
e Appendix C)

note underlying unit of unknown depth

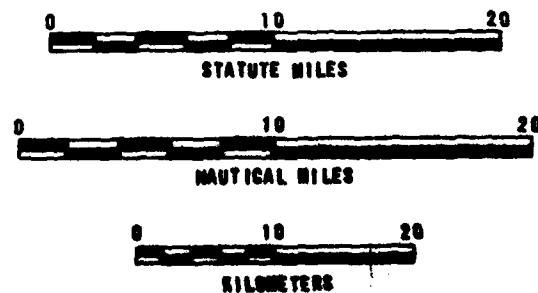
geologic units, see Drawing 2.

EXAGGERATION: 10X

LOCATION MAP

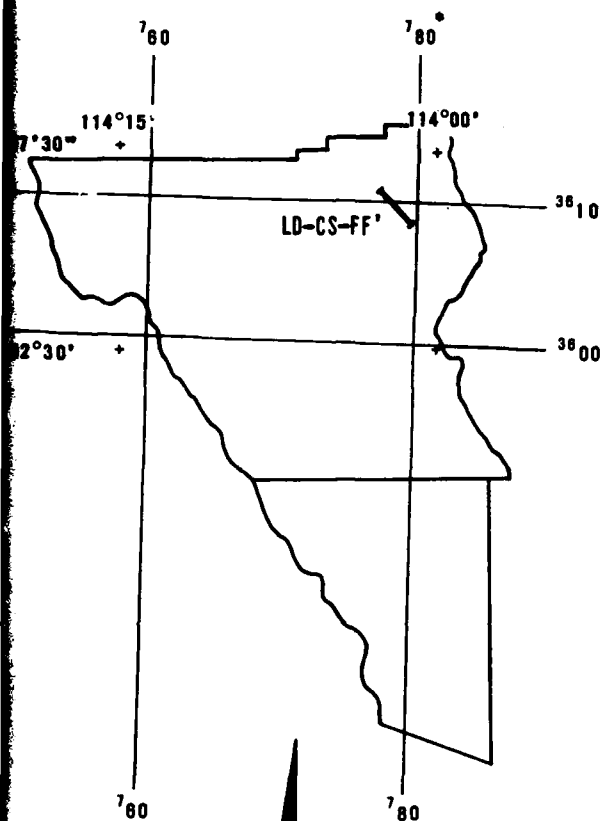


1:500,000



*NOTE: See Appendix page C-5 for explanation Universal Transverse Mercator Grid System.

LOCATION MAP



1:500,000



GEOLOGIC CROSS SECTION
LD-CS-FF'
LECHUGUILLA DESERT, ARIZONA

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - SANSO

FIGURE
B-6

NOTE: See Appendix page C-5 for explanation Universal Transverse Mercator Grid System.

FUERO NATIONAL INC.

5

DATA TABLE

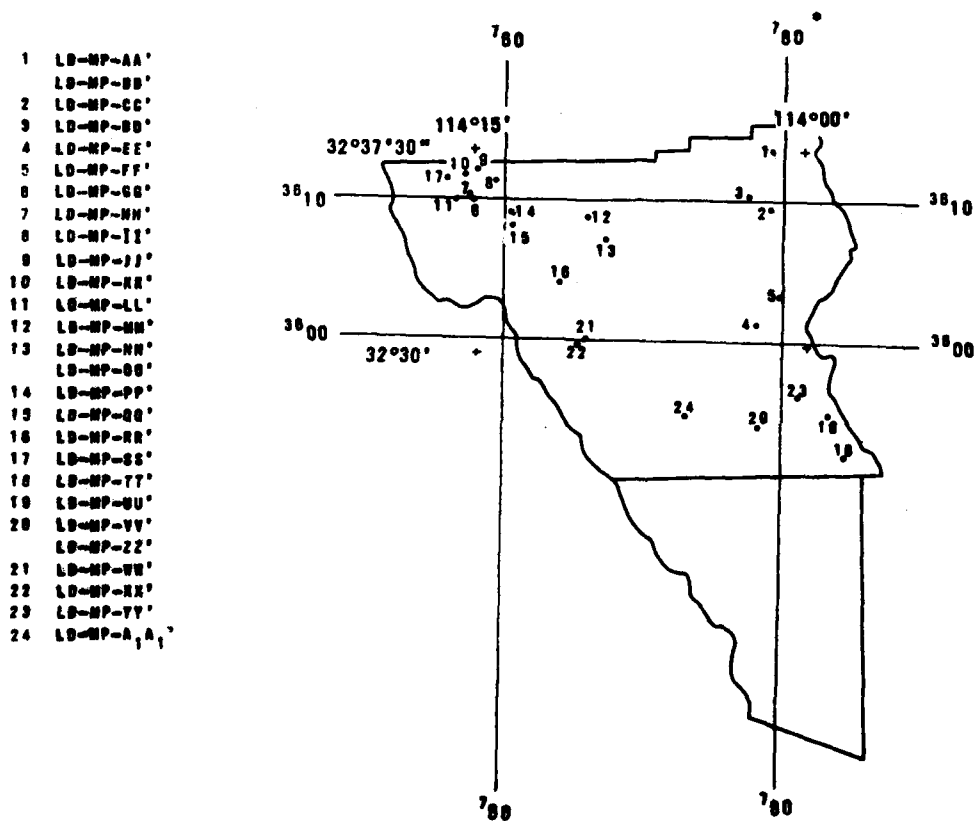
MICRO-RELIEF PROFILE	GEOLOGIC UNIT(S) TRANSVERSED	DATA SHEET (in Data Bank)	ASSOCIATED FIELD STATION
LD-MP-AA'	A5iy	206A	LD-FS-3
LD-MP-BB'	A5iy	206B	LD-FS-3
LD-MP-CC'	A5i	206C	LD-FS-25
LD-MP-DD'	A5yf(A5if)	206D	LD-FS-27
LD-MP-EE'	A5i	206E	LD-FS-43
LD-MP-FF'	A5i	206F	LD-FS-49
LD-MP-GG'	A5oc	206G	LD-FS-75
LD-MP-HH'	A5iyc, A1/A5y	206H	LD-FS-77
LD-MP-II'	A5i	206I	LD-FS-91
LD-MP-JJ'	A5iy	206J	LD-FS-93
LD-MP-KK'	A5i	206K	LD-FS-79
LD-MP-LL'	A5oc, A5i(A5oc)	206L	LD-FS-95
LD-MP-MM'	A5yf(A5if)	206M	LD-FS-4
LD-MP-NN'	A5i	206N	LD-FS-6
LD-MP-OO'	A5i	206O	LD-FS-6
LD-MP-PP'	A5iy, A1/A5y	206P	LD-FS-12
LD-MP-QQ'	A5ic	206Q	LD-FS-22
LD-MP-RR'	A5iy	206R	LD-T-18
LD-MP-SS'	A5oc	206S	LD-FS-97
LD-MP-TT'	A5yf, A3d	206T	LD-FS-102
LD-MP-UU'	A5iyf	206U	LD-FS-105
LD-MP-VV'	A1/A5yf	206V	LD-FS-100
LD-MP-WW'	A5iyf, A5yf(A5if)	206W	LD-T-15
LD-MP-XX'	A5if, A5yf(A5if)	206X	LD-FS-40
LD-MP-YY'	A5if	206Y	LD-FS-110
LD-MP-ZZ'	A5yf	206Z	LD-FS-100
LD-MP-A ₁ A ₂ '	A5yf, A5iyf(A5if)	206AA	LD-FS-158

1 LD-
2 LD-
3 LD-
4 LD-
5 LD-
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22 LD-
23 LD-
24 LD-

EXPLANATION

- 6
• Traverse rod point
- LD-FS-104
▲ Geologic field station - complete data stop

LOCATION MAP



*NOTE: See Appendix page C-5 for explanation of Universal Transverse Mercator Grid System.

**MICRORELIEF PROFILE EXPLANATION
SONORAN DESERT, ARIZONA**

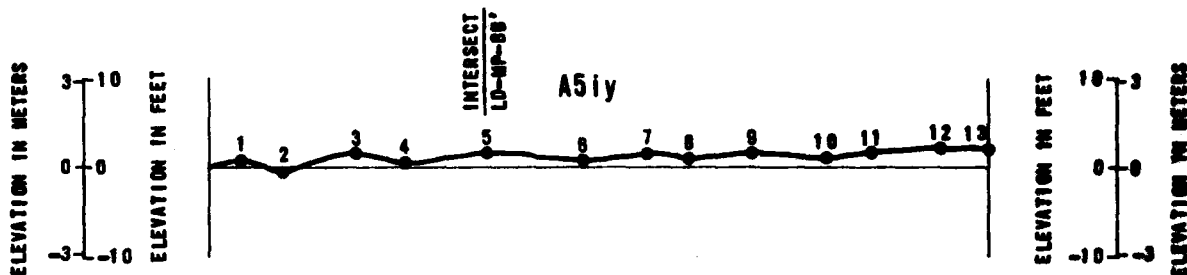
MR SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - SAGMO

FIGURE

101

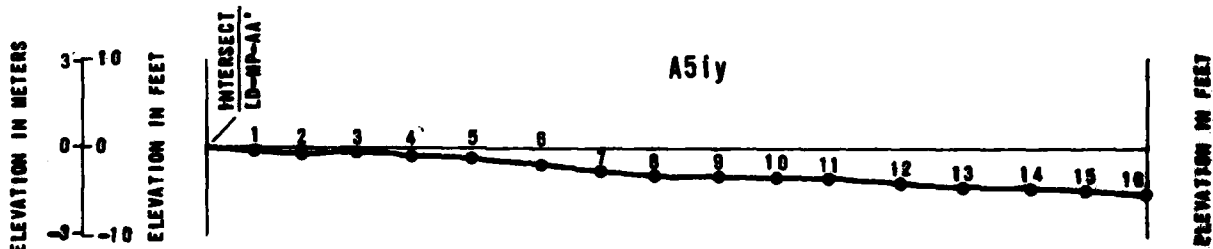
MICRORELIEF PROFILE LD-MP-AA'

N15E



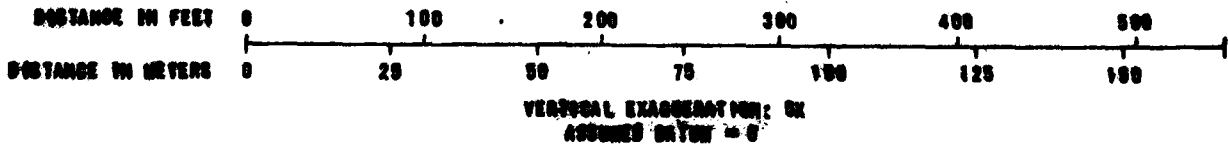
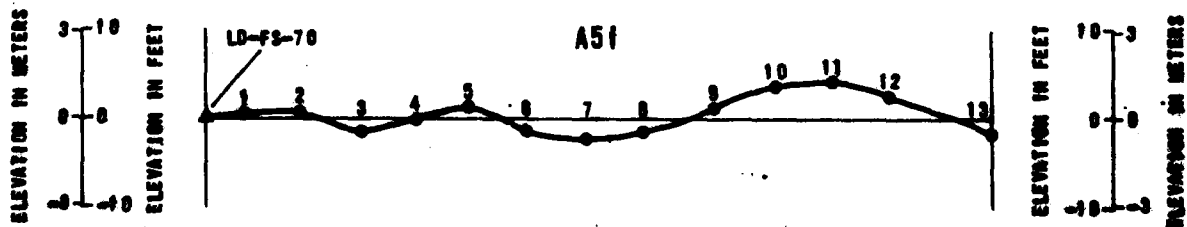
MICRORELIEF PROFILE LD-MP-BB'

N62W

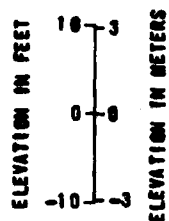


MICRORELIEF PROFILE LD-MP-CC'

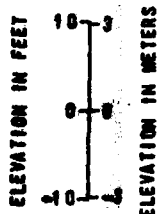
N30E



AA'



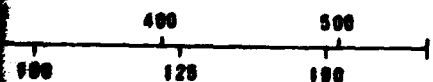
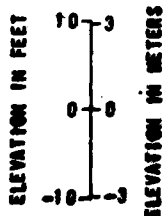
LD-MP-BB'



NOTES:

1. See Drawing B-1 for locations of profiles relative to geologic units.
2. See Figure B-7 for list of associated geologic field stations, for locations of individual profiles, and for explanation of profile symbols.

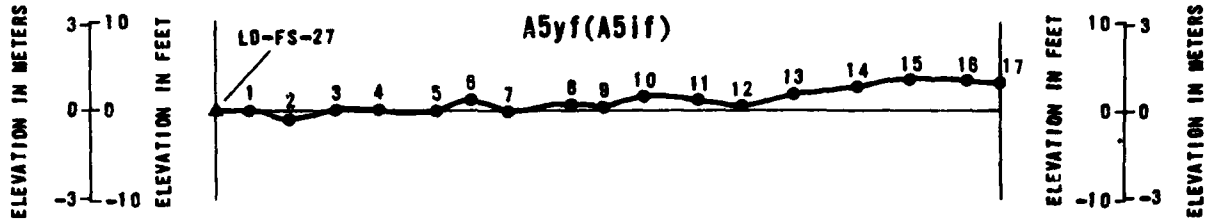
MP-CC'



MX SITING INVESTIGATION DEPARTMENT OF THE AIR FORCE - SANSO		FIGURE B-7
FEDERAL BUREAU OF SURVEY		

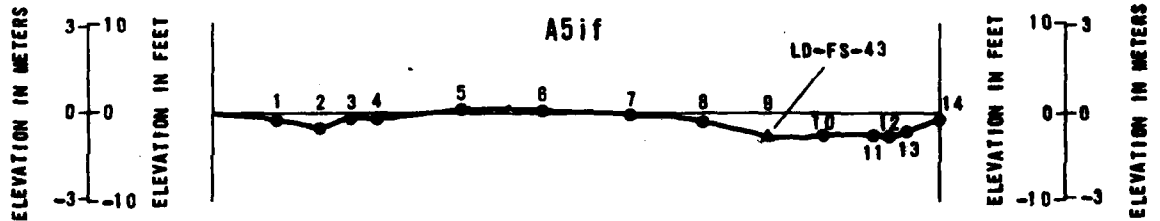
MICRORELIEF PROFILE LD-MP-DD'

S27E



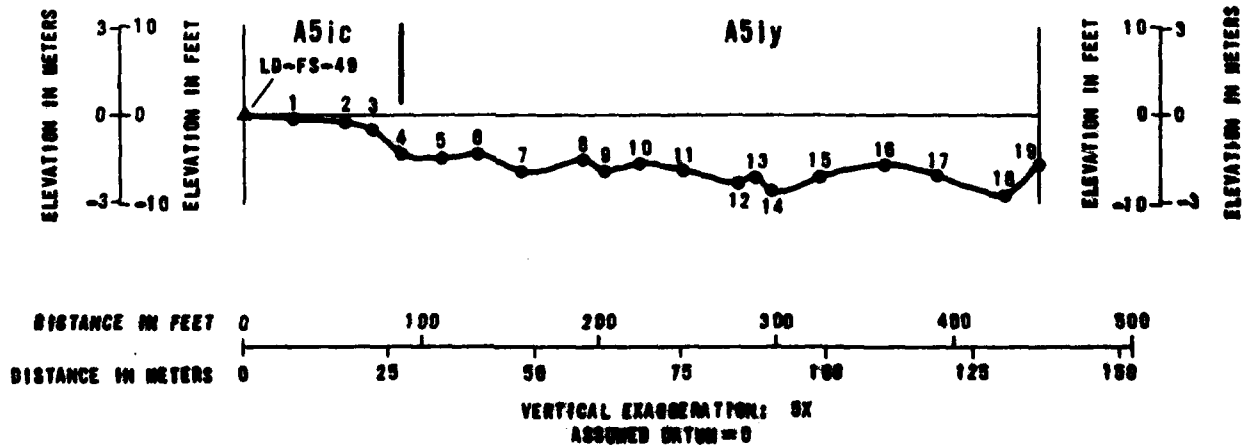
MICRORELIEF PROFILE LD-MP-EE'

S25W

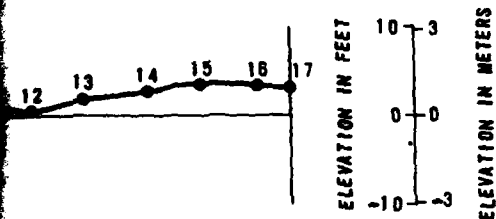


MICRORELIEF PROFILE LD-MP-FF'

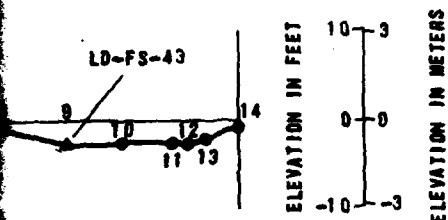
S80W



D-MP-DD'



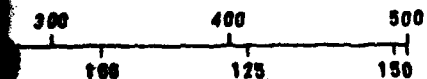
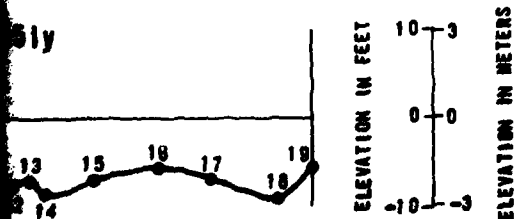
MP-EE'



NOTES:

1. See Drawing B-1 for locations of profiles relative to geologic units.
2. See Figure B-7 for list of associated geologic field stations, for locations of individual profiles, and for explanation of profile symbols.

LD-MP-FF'

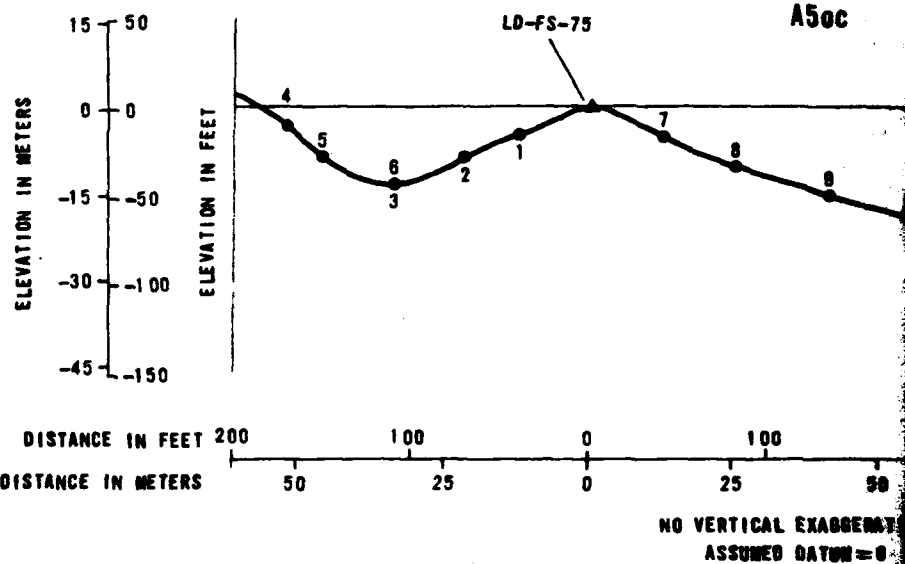


MS SX

<p>MX SITING INVESTIGATION DEPARTMENT OF THE AIR FORCE - SANSO</p>		<p>FIGURE</p>
<p>INTERNATIONAL INC.</p>		<p>2</p>

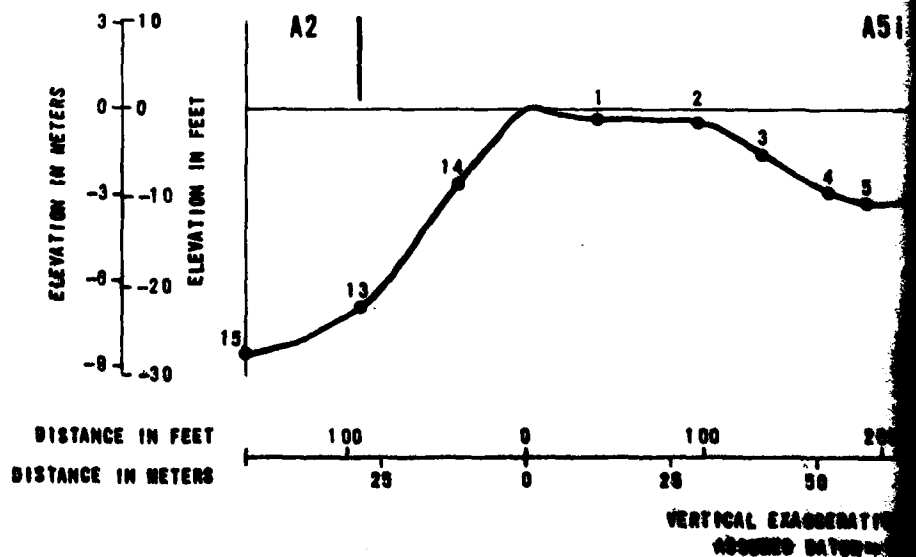
MICRORELIEF PROFILE

N55W



MICRORELIEF PROFILE

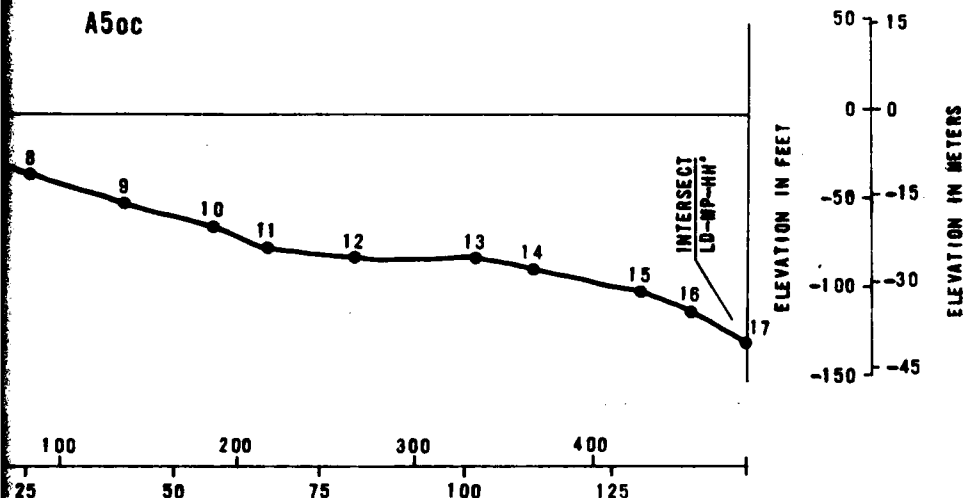
N71W



LIEF PROFILE LD-MP-GG'

N55W

A50c



VERTICAL EXAGGERATION
ASSUMED DATUM=0

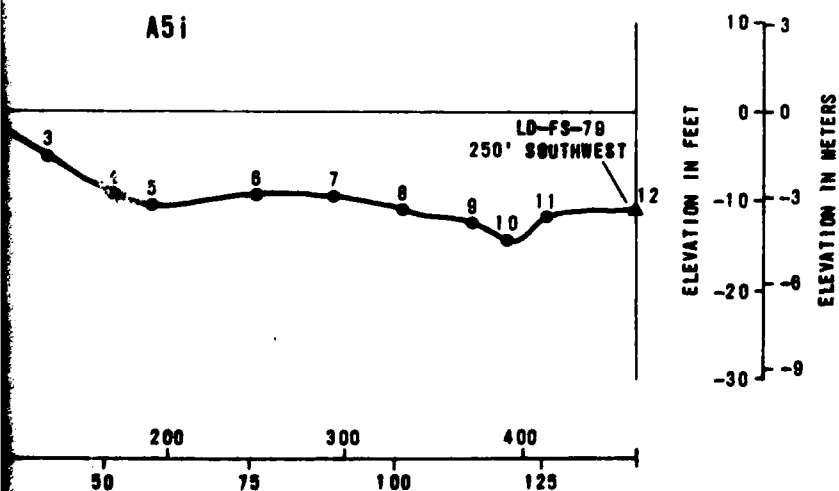
NOTES:

1. See Drawing B-1 for locations of profiles relative to geologic units.
2. See Figure B-7 for list of associated geologic field stations, for locations of individual profiles, and for explanation of profile symbols
3. Profiles not in alphabetical order.

F PROFILE LD-MP-KK' (3)

N71W

A5i

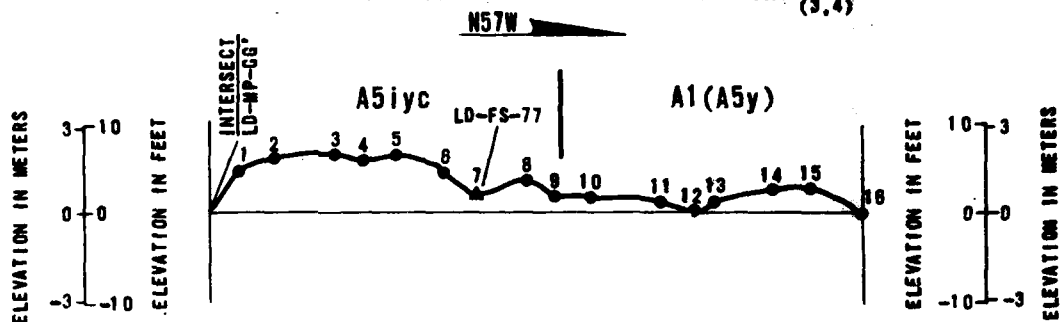


VERTICAL EXAGGERATION: 5X
ASSUMED DATUM=0

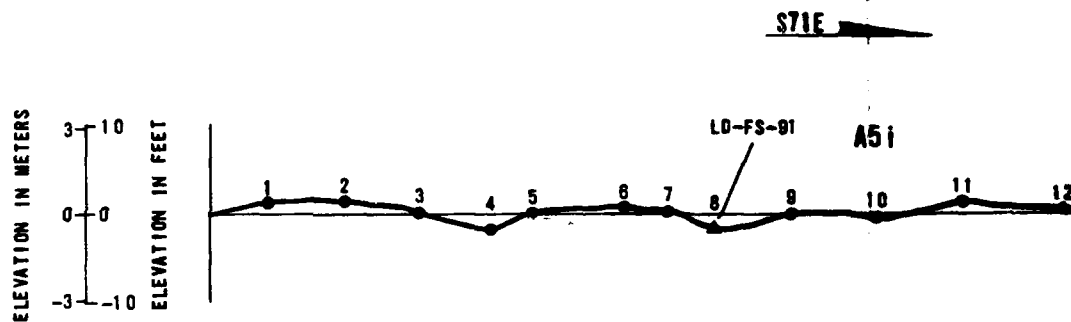
MX SITING INVESTIGATION DEPARTMENT OF THE AIR FORCE - SANSO		FIGURE 1
INTERNATIONAL		

2

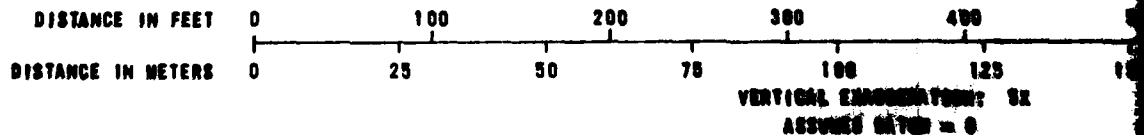
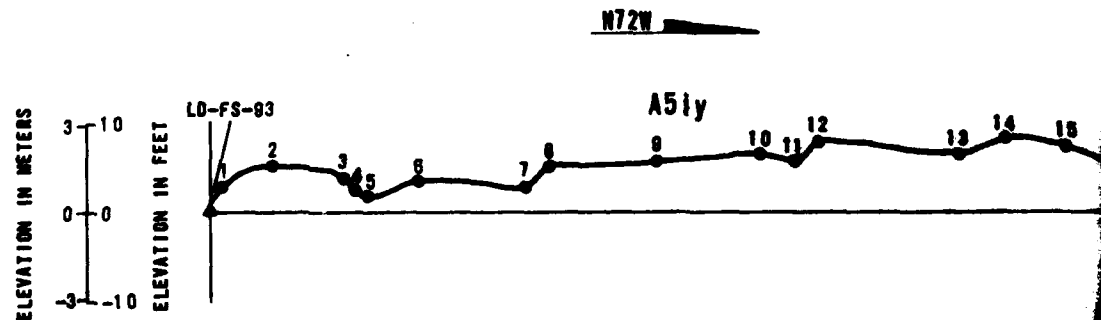
MICRORELIEF PROFILE LD-MP-HH⁰ (3,4)



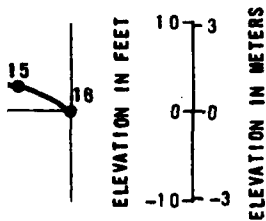
MICRORELIEF PROFILE LD-MP-II'



MICRORELIEF PROFILE LD-MP-JJ'

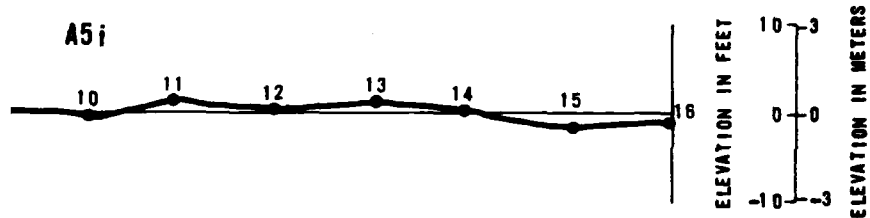


(3,4)



PROFILE LD-MP-11'

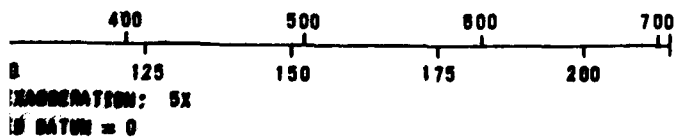
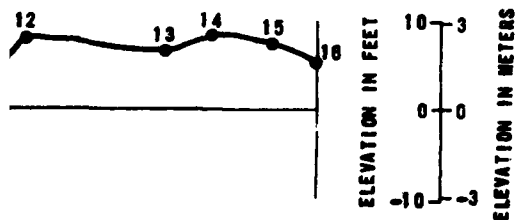
1E



NOTES:

1. See Drawing B-1 for locations of profiles relative to geologic units.
2. See Figure B-7 for list of associated geologic field stations, for locations of individual profiles, and for explanation of profile symbols.
3. Profiles not in alphabetical order.
4. See Figure B-10 for Profile LD-MP-66'.

-MP-JJ'



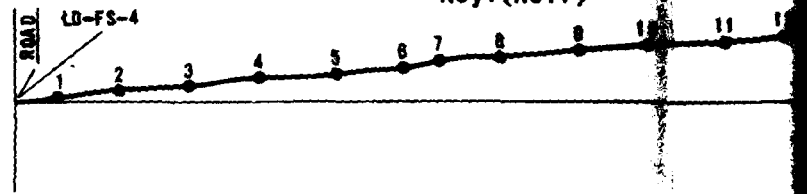
MX SITING INVESTIGATION		FIGURE
DEPARTMENT OF THE AIR FORCE - SANJO		
FUSED NATIONAL MAP		

MICRORELIEF PROFILE LD-MP-MM'

S74W

ELEVATION IN METERS
3 10
0 0
-3 -10
ELEVATION IN FEET

A5yf(A5if)



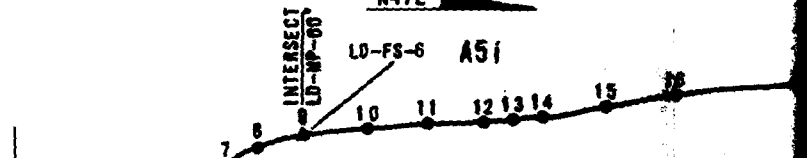
MICRORELIEF PROFILE LD-MP-MM'

N47E

ELEVATION IN METERS
3 10
0 0
-3 -10
ELEVATION IN FEET

INTERSECT
LD-MP-00'

LD-FS-6 A5i



MICRORELIEF PROFILE LD-MP-00'

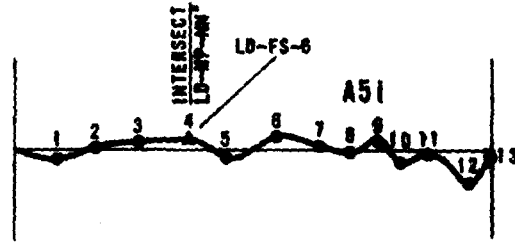
S20E

ELEVATION IN METERS
3 10
0 0
-3 -10
ELEVATION IN FEET

INTERSECT
LD-MP-MM'

LD-FS-6

A5i



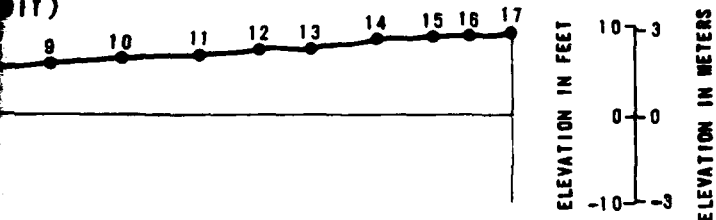
ELEVATION IN FEET
10 3
0 0
-10 -3
ELEVATION IN METERS

DISTANCE IN FEET 0 100 200 300 400
DISTANCE IN METERS 0 25 50 75 100 125

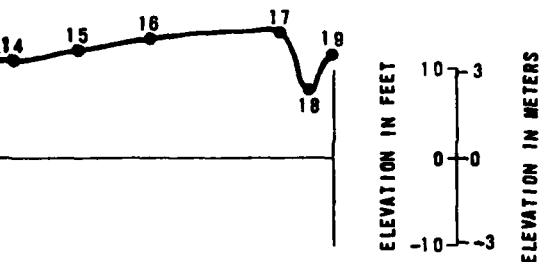
VERTICAL EXAGGERATION: 2X
ASSUMED SLOPE: 0

FILE LD-MP-MM'

(if)

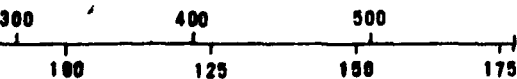
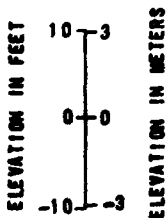


LD-MP-NN'



NOTES:

1. See Drawing B-1 for locations of profiles relative to geologic units.
2. See Figure B-7 for list of associated geologic field stations, for locations of individual profiles, and for explanation of profile symbols.

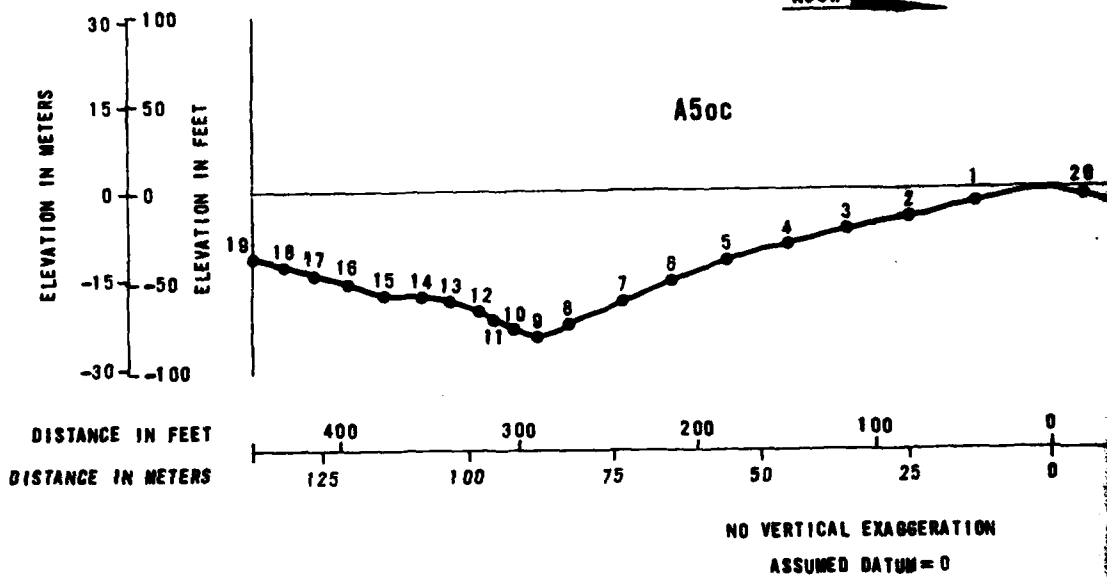


TON: 5X
m 8

<p>UX SITING INVESTIGATION DEPARTMENT OF THE AIR FORCE - SANDS</p>		<p>FIGURE</p>
--	--	---------------

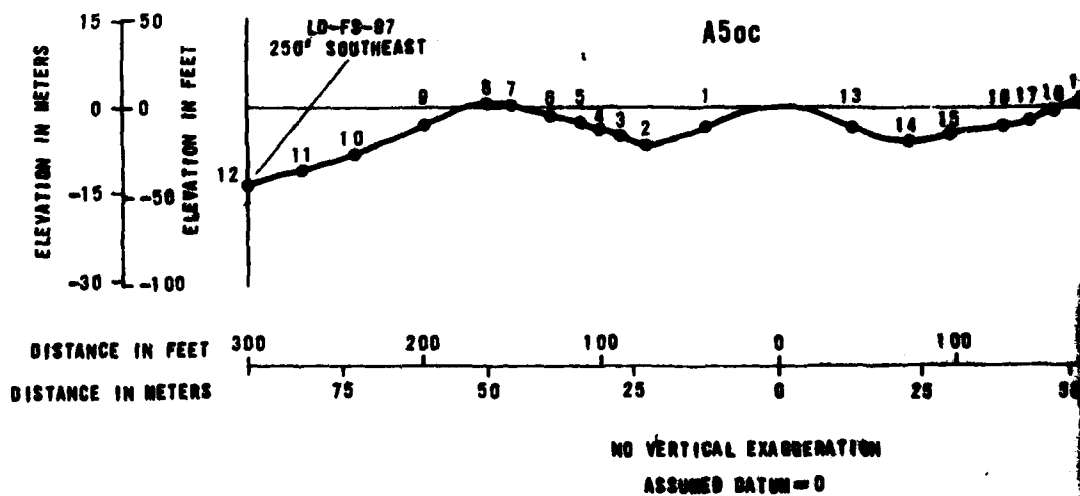
MICRORELIEF PROFILE LD-MP-LL'

N55W



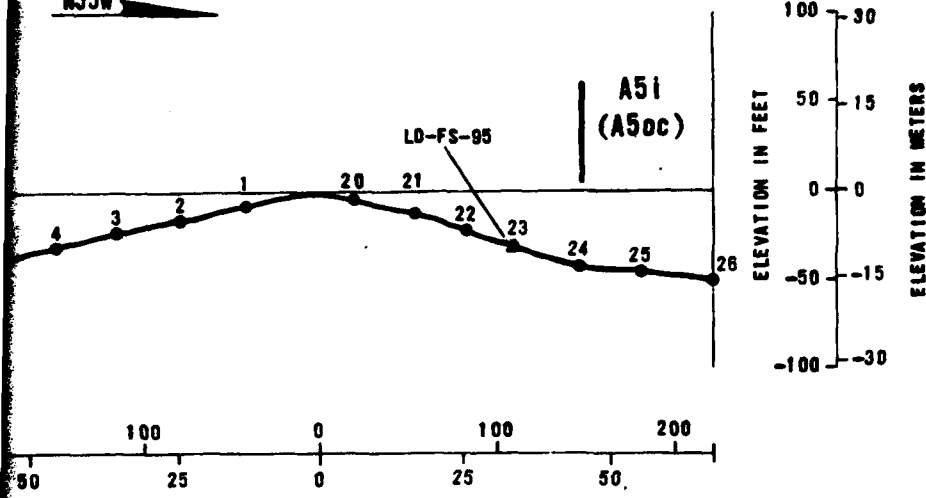
MICRORELIEF PROFILE LD-MP-SS' (3,4)

N45W



EF PROFILE LD-MP-LL'

N55W

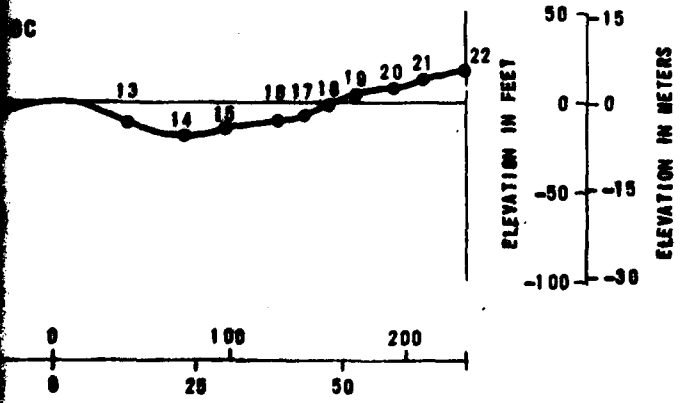


VERTICAL EXAGGERATION
ASSUMED DATUM = 0

NOTES:

1. See Drawing B-1 for locations of profiles relative to geologic units.
2. See Figure B-7 for list of associated geologic field stations, for locations of individual profiles, and for explanation of profile symbols.
3. Profiles not in alphabetical order.
4. See Figure B-15 for Profile LD-MP-RR'

FILE LD-MP-SS' (3,4)



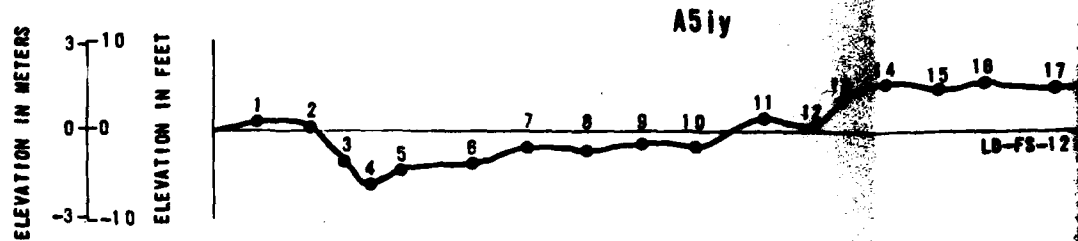
EXAGGERATION
DATUM = 0

MK SITING INVESTIGATION
 DEPARTMENT OF THE AIR FORCE - SANSO

FIGURE

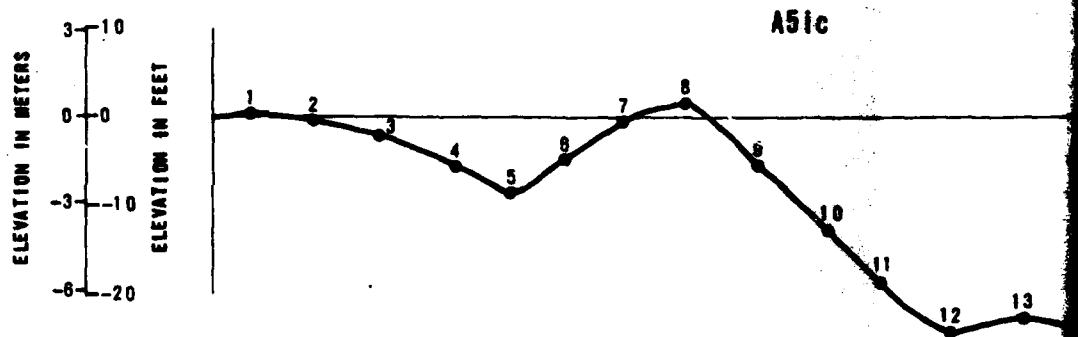
MICRORELIEF PROFILE LD-PP'

N83W



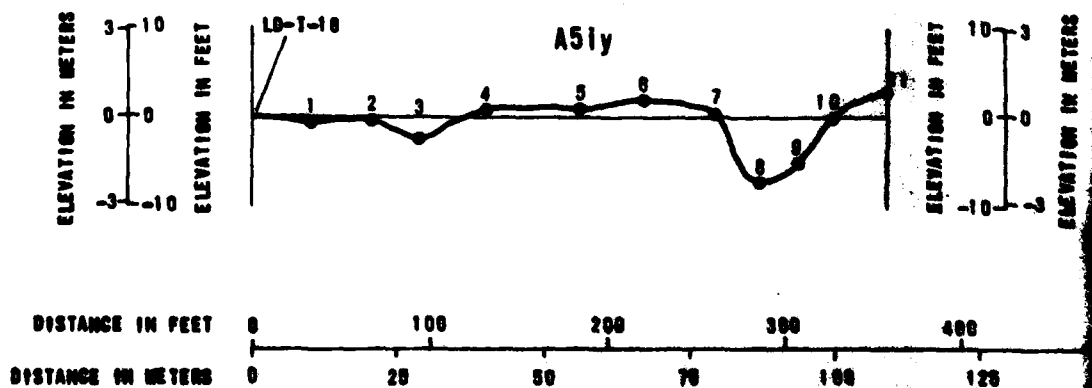
MICRORELIEF PROFILE LD-MP-QQ'

S50E



MICRORELIEF PROFILE LD-MP-RR'

N23W



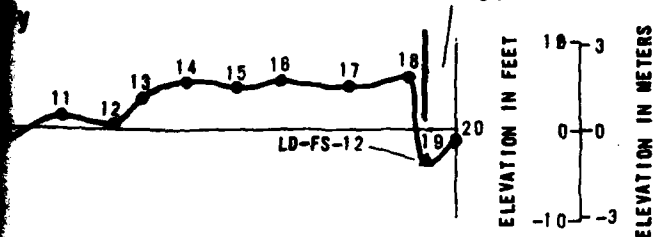
DISTANCE IN FEET

DISTANCE IN METERS

VERTICAL SCALE: 1" = 10'

FILE LD-MP-PP'

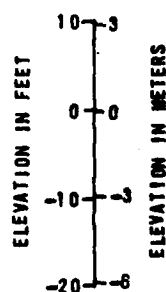
A1(A5y)



EF PROFILE LD-MP-QQ'

S50E

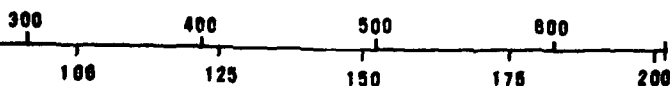
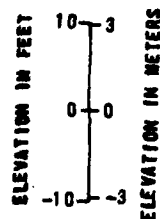
A5ic



NOTES:

1. See Drawing B-1 for locations of profiles relative to geologic units.
2. See Figure B-7 for list of associated geologic field stations, for locations of individual profiles, and for explanation of profile symbols.

P-RR'



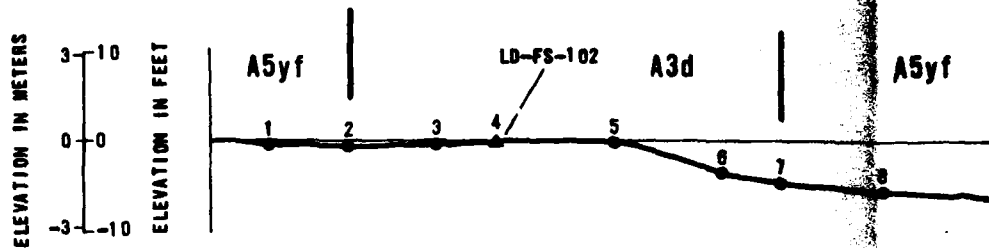
VERTICAL EXAGGERATION: 5X
ASSUMED DATUM = 0

AN SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - SANDO

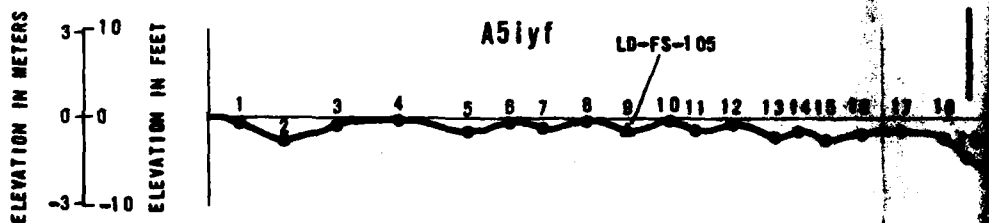
FIGURE

2

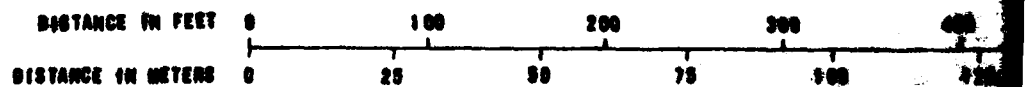
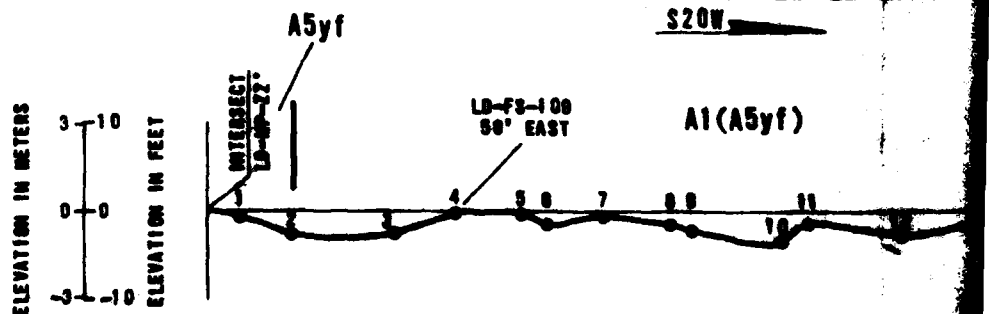
MICRORELIEF PROFILE LD-MP-TT' S7E



MICRORELIEF PROFILE LD-MP-UU' S45W



MICRORELIEF PROFILE LD-MP-VV' S20W



VERTICAL EXAGGERATION: 2X
ASSUMED DATUM = 0

LD-MP-TT'

A5yf

ELEVATION IN FEET
10
0
-10
ELEVATION IN METERS
3
0
-3

PROFILE LD-MP-UU'

A1

ELEVATION IN FEET
10
0
-10
ELEVATION IN METERS
3
0
-3

NOTES:

1. See Drawing B-1 for locations of profiles relative to geologic units.
2. See Figure B-7 for list of associated geologic field stations, for locations of individual profiles, and for explanation of profile symbols.

PROFILE LD-MP-VV'

(A5yf)

ELEVATION IN FEET
10
0
-10
ELEVATION IN METERS
3
0
-3

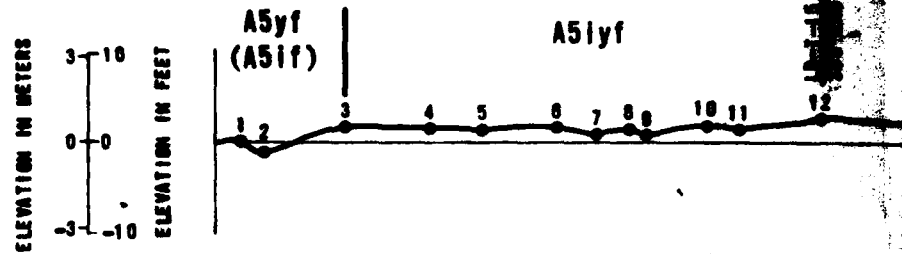
300 400 500
100 125 150 175

MR SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - SANSO

FIGURE

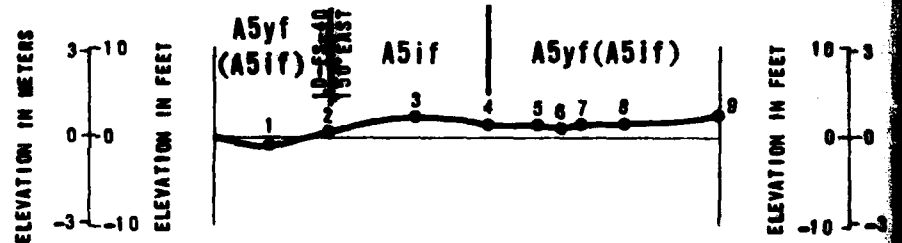
MICRORELIEF PROFILE 12

N33W



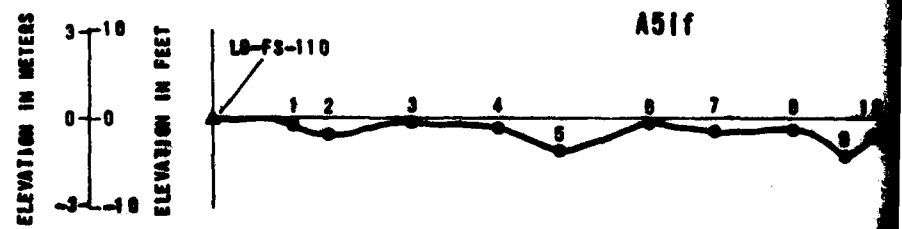
MICRORELIEF PROFILE LD-MP-XX'

N20W



MICRORELIEF PROFILE LD-MP-XX'

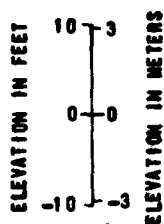
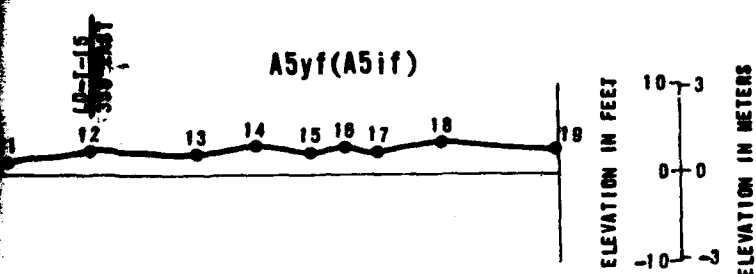
N3W



DISTANCE IN FEET 0 100 200 300
DISTANCE IN METERS 0 25 50 75 100

VERTICAL EXAGGERATION:
SLOPED GRAD = 0

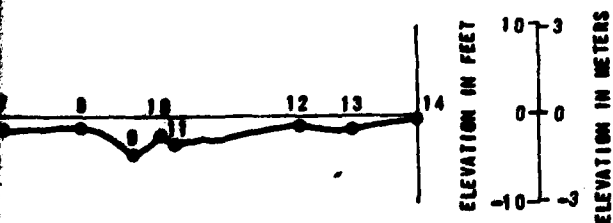
PROFILE LD-MP-WW'



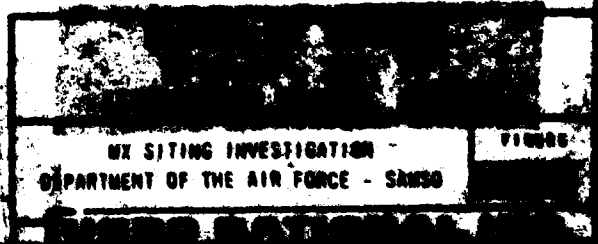
NOTES:

1. See Drawing B-1 for locations of profiles relative to geologic units.
2. See Figure B-7 for list of associated geologic field stations, for locations of individual profiles, and for explanation of profile symbols.

LE LD-MP-YY'

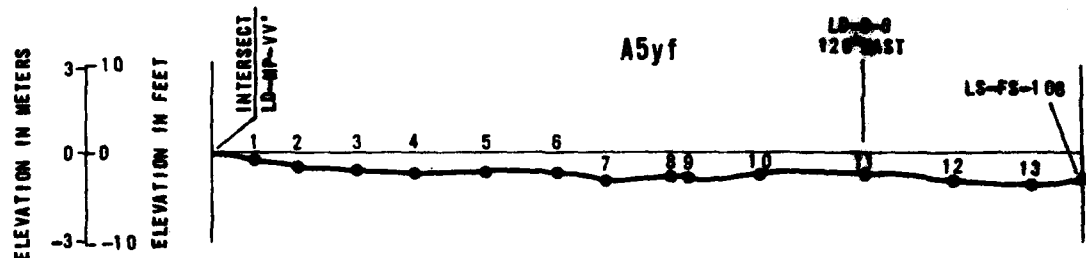


EXAGGERATION: 5X
RED DATUM: 0'



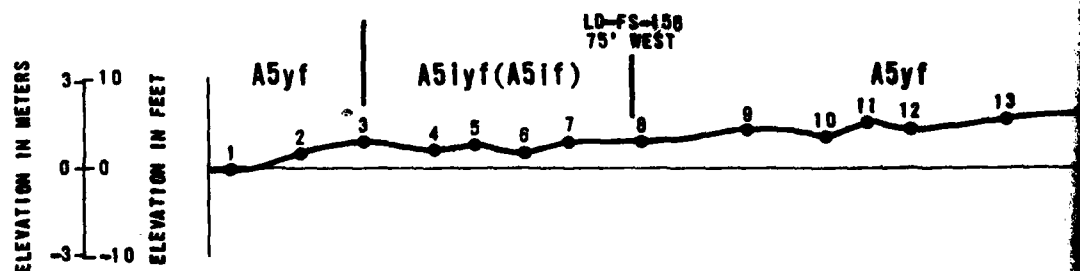
MICRORELIEF PROFILE LD-MP-ZZ'

N20E



MICRORELIEF PROFILE LD-MP-A₁A₁'

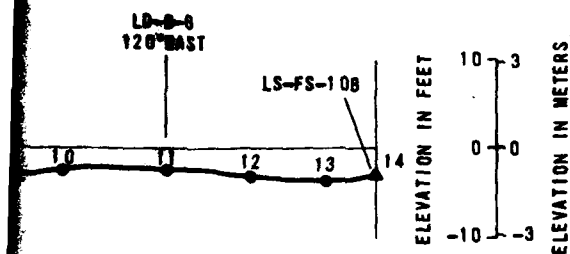
S30E



DISTANCE IN FEET 0 100 200 300 400
 DISTANCE IN METERS 0 25 50 75 100 125

VERTICAL EXAGGERATION: 5X
 ASSUMED DATUM = 0

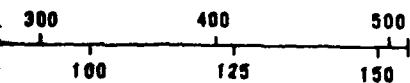
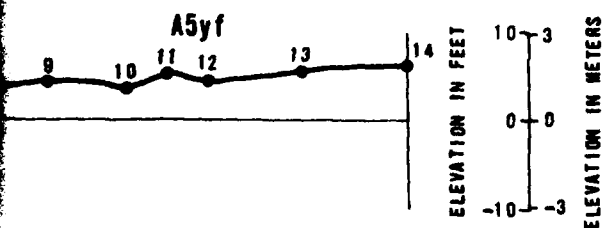
LD-MP-22'





NOTES:

1. See Drawing B-1 for locations of profiles relative to geologic units.
2. See Figure B-7 for list of associated geologic field stations, for locations of individual profiles, and for explanation of profile symbols.

LE LD-MP-A₁A₁'



Scale: 5X

	
MX SITING INVESTIGATION DEPARTMENT OF THE AIR FORCE - SANSO	FIGURE 

2

STATION NUMBER ①	ENGINEERING GEOLOGY UNIT ②	DESCRIPTIVE NAME(S)	USCS SYMBOL(S)	GRADATION	PLASTICITY OF FINES	MAXIMUM GRAIN SIZE	APPROXIMATE	
							COBBLES BOULDER (% OF TOTAL)	③
LD-FS-1	A5iy	Sand w/silt and gravel	SP	Mod	None	Cobble	<1	
LD-FS-2	A5oc	Sandy Gravel w/ boulders and cobbles	GP	Poor	None	Boulder	60	
LD-FS-3	A5iy	Sand w/silt and gravel	SP	Mod	None	Boulder	<5	
LD-FS-4	A5yf (A5if)	Silty Sand	SM	Mod	None	Gravel	0	
LD-FS-6	A5i	Sand w/silt	SP	Mod	None	Cobble	<5	
LD-FS-7	A5iy	Sand w/silt	SP	Mod	None	Cobble	<1	
LD-FS-8	A5iyf	Gravelly Sand w/silt	SP	Mod	None	Fine Gravel	0	
LD-FS-10	A5yf (A5if)	Sand w/silt	Sp	Mod	None	Coarse Gravel	0	
LD-FS-12	A5iy	Silty Sand w/ gravel	SM	Mod	None	Cobble	<2	
LD-FS-12	A5i (buried)	Gravelly Sand w/silt	SP	Mod	None	Cobble	5-10	
LD-FS-13	A5iy	Sandy Gravel w/silt, cobbles and boulders	GP	Mod	None	Boulder	20	
LD-FS-14	A5ic	Silty Sand	SM	Poor	Low	Cobble	--	
LD-FS-15	A5if	Silty Sand w/gravel	SM	Poor	Low	Coarse Gravel	0	
LD-FS-22	A5ic	Gravelly Sand w/silt, cobbles and boulders	SP	Mod	None	Boulder	10	

NOTES: ① Includes only complete data stops designated by symbol (▲) on Drawing 2.

② Where buried or mixed unit symbol occurs data are on unit listed first except where second unit is underlined. Where more than one layer is distinguished within one unit, numbering is from base to top.

③ Boulders, cobbles, and coarse gravel only. Rock type symbols: Metamorphic (M), Sedimentary (S), Igneous intrusive (I1), or igneous extrusive (I2).

④ Data in brackets indicate depth to and stage of caliche in buried unit. Caliche absent in upper unit.

MATERIAL PROPERTIES

APPROXIMATE SIZE DISTRIBUTION				ROCK TYPE(S) ③	GRAIN SHAPE	MUNSELL COLOR	MOISTURE CONTENT	CONSISTANCY	WEATHERING ③	STRUCTURE	CEMENT
SILTS (CLAYERS TOTAL)	PERCENT OF FRACTION ≤ 3 INCHES (76mm)										
	GRAVEL	SAND	FINES								
<1	10	80	10	IL,M	Ang-Subrnd	10YR 6/4	Dry	Loose	Fresh-Slight	Nonstrat	Non
60	80	18	2	M	Subang-Subrnd	10YR	Dry	Dense	Mod-Very	Strat (weak)	Mod
<5	10	80	10	M,IL	Ang-Rnd	2.5YR 4/8	Dry	Dense	Mod-Very Some Fresh	Strat (Mod)	Mod
0	1	85	14	---	Subang-Subrnd	10YR 6/4	Dry	Loose-Dense	---	Strat	Weak
<5	<5	85	10	M	Ang-Subang	7.5YR 5/4	Dry	Med Dense	Slight-Mod	Nonstrat	Mod
<1	5	85	10	M	Subang	7.5YR 6/4	Dry	Med Dense	Fresh-Slight	Nonstrat	Weak
0	20	70	10	M	Subang-Subrnd	7.5YR 6/4	Dry	Med Dense	Mod	Nonstrat	Weak
0	5	85	10	---	Subang	7.5YR6/10	Dry	Med Dense	---	Nonstrat	Weak
<2	10	70	20	M	Subrnd	10YR 6/4	Dry	Med Dense	Mod-Very	Upr Non-Lwr Strat	Weak
-10	15	75	10	M	Subrnd	10YR 6/2	Dry	Dense-V. Dense	Mod-Very	Strat (w/lenses)	Str
20	60	30	10	M,IL	Subang-Subrnd	---	Dry	Dense	Mod	Nonstrat	Weak Mod
--	5	80	15	M	Subang	7.5YR 6/6	Dry	Med Dense	Mod-Very	Nonstrat	Weak
0	10	70	20	IL,M	Ang-Subrnd	7.5YR 6/6	Dry	Med Dense	Mod-Very	Nonstrat	Weak
10	20	70	10	M	Subang-Subrnd	7.5YR 6/6	Dry	Med Dense	Very	Nonstrat	Mod

(5) Measured from USGS Topographic Maps (1:24000, 1:62500) in general vicinity of data point.

			SURFACE SOIL DEVELOPMENT			SURFACE MORPHOLOGY			
RING	STRUCTURE	CEMENTATION	PAVEMENT PATINA	B HORIZON	CALICHE ④ DEPTH / STAGE INCHES(mm) / (TABLE E-4)	SLOPE (%) ⑤	MAXIMUM MICRO- RELIEF FEET (METERS)	INCISION DEPTH WIDTH FEET (METERS)	STREAM GRADIENT (%) ⑤
ht	Nonstrat	None	Poor/ None	None	None	1.5	3(0.9)	20 (6.11)/ 100 (30.5)	---
Very Very	Strat (weak)	Mod	Poor/ Poor	None	--- / II-III	---	---	9.8 (3)/ 65.6 (20)	3.2
	Strat (Mod)	Mod	--/ --	---	--- / II	---	2(0.6)	10 (3)/ 125 (38.1)	---
	Strat	Weak	Poor/ None	None	0 / I	0.9	---	None	---
at-	Nonstrat	Mod	Well/ Fair	Poor	1(25)/ II	---	3.5 (0.8)	-----	3.2
at	Nonstrat	Weak	Fair/ Poor	None	--- / II	1.5	---	1.5 (.5)/ 15 (4.6)	---
d	Nonstrat	Weak	Poor- Fair/ None	None	8(203)/ II	1.0	---	-----	1.0
	Nonstrat	Weak	Poor/ None	None	--- / I	1.3	<1 (0.3)	None	---
Very	Upr Non- Lwr Strat	Weak	Fair- Poor/ Poor	None	56(1422) / I-II	1.0	4(1.2)	1-3 (0.3-1) 10-15 (3-5)	1.0
Very	Strat (w/lenses)	Strong	--/ --	---	--- / I-II	---	---	-----	---
d	Nonstrat	Weak- Mod	Fair/ Fair	Poor	--- / I	1.6	---	8 (2.4)/ 25 (7.6)	---
Very	Nonstrat	Weak	Fair- Well/ Fair	None	0 / II	2.0	---	-----	---
Very	Nonstrat	Weak	Well/ Well	Poor	--- / II	---	---	7 (2.1)/ 25 (7.6)	---
ry	Nonstrat	Mod	Well/ Well	None	4 (102) / II	---	10(3)	20 (6.1)/ 195 (59.4)	1.6

PHYSICAL PROPERTIES COMPILED FROM
FIELD OBSERVATIONS - PAGE 1 OF 9
LECHUGUILLA DESERT, ARIZONA

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE SAUSO

TABLE
B-1

FUGRO NATIONAL, INC.

STATION NUMBER ①	ENGINEERING GEOLOGY UNIT ②	DESCRIPTIVE NAME(S)	USCS SYMBOL(S)	GRADATION	PLASTICITY OF FINES	MAXIMUM GRAIN SIZE	APPROXIMATE	
							COBBLES BOULDERS (% OF TOTAL)	GRA
LD-FS-23	A5i	Sand w/gravel, cobbles and boulders	SP	Poor	None	Boulder	15	1
LD-FS-26	A5if	Silty Sand	SM	Mod	None	Coarse Gravel	0	<
LD-FS-27	A5yf (A5if)	Sand	SP	Mod	None	Cobble	<1	<
LD-FS-28	A5yf (A5if)	Silty Sand	SM	Mod	None	Coarse Gravel	0	
LD-FS-33	A5if	Sand w/silt	SP	Poor	Low	Gravel	0	<
LD-FS-34	A5iyf (A5if)	Silty Sand	SM	Mod	None	Fine Gravel	0	
LD-FS-35	A5yf	Sand w/silt	SP	Mod	None	Gravel	0	<
LD-FS-36	A5yf (A5if)	Silty Sand	SM	Mod	None	Fine Gravel	0	
LD-FS-38	A5iyf (A5if)	Silty Sand	SM	Mod	None	Coarse Gravel	0	
LD-FS-40	A5if	Sand w/gravel	SP	Poor	None	Fine Gravel	0	
LD-FS-41	A5if	Silty Sand	SM	Poor	None	Cobble	<1	
LD-FS-42	A5iy	Silty Sand w/gravel	SM	Mod	None	Fine Gravel	0	
LD-FS-43	A5if	Silty Sand w/gravel	SM	Mod	None	Cobble	<1	
LD-FS-44	A5iy	Silty Sand w/gravel	SM	Mod	None	Boulder	5	

NOTES: ① Includes only complete data steps designated by symbol (▲) on Drawing 2.

② Where buried or mixed unit symbol occurs data are on unit listed first except where second unit is underlined. Where more than one layer is distinguished within one unit, numbering is from base to top.

③ Boulders, cobbles, and coarse gravel only. Rock type symbols: Metamorphic (M), Sedimentary (S), Igneous intrusive (I), or Igneous extrusive (E).

④ Data in brackets indicate depth to and stage of caliche in buried unit. Caliche absent in upper unit.

MATERIAL PROPERTIES

SIZE	APPROXIMATE SIZE DISTRIBUTION				ROCK TYPE(S) (3)	GRAIN SHAPE	MUNSELL COLOR	MOISTURE CONTENT	CONSISTANCY	WEATHERING (3)	STRUCTURE	GENERAL
	COBBLES BOULDERS (% OF TOTAL)	OF FRACTION ≤ 3 INCHES (76mm)										
		GRAVEL	SAND	FINES								
	15	10	85	5	M	Ang-Subrnd	---	Dry	Med Dense	Mod	Nonstrat	
	0	<5	75	20	M	Subang	7.5YR 6/6	Dry	Dense	Fresh	Nonstrat	Se
	<1	<1	97	<3	M	Subang-Subrnd	10YR 6/4	Dry	Med Dense	Fresh	Nonstrat	We
	0	5	80	15	M	Subang-Subrnd	10YR 6/6	Dry	Med Dense	Fresh	Nonstrat	We
	0	<1	90	10	---	Ang-Subrnd	7.5YR 6/6	Dry	Loose-Dense	Very	Nonstrat	M St
	0	5	80	15	---	Subang	7.5YR 6/6	Dry	Med Dense-Dense	---	Nonstrat	We M
	0	<5	85	10	M	Subang-Subrnd	7.5YR 6/8	Dry	Med Dense	---	Nonstrat	We
	0	5	75	20	---	Subang-Rnd	7.5YR 6/6	Dry	Loose - Med Dense	---	Nonstrat	We
	0	5	80	15	M	Subang-Subrnd	7.5YR 6/6	Dry	Med Dense	---	Nonstrat	We
	0	10	85	5	---	Ang-Subang	5YR 6/6 7.5YR 6/6	Dry	Med Dense	Mod	Nonstrat	
	<1	5	65	30	---	Ang-Subang	7.5YR 6/4	Dry	Loose-Med Dense	Slight	Nonstrat	
	0	10	75	15	Il	Ang-Subang	7.5YR 7/6	Dry	Med Dense	None	Nonstrat	We
	<1	10	70	20	M, Il	Subang-Subrnd	7.5YR 7/4	Dry	Med Dense	Mod-Very	Nonstrat	We
	5	10	75	15	Il	Ang-Subrnd	7.5YR	Dry	Med Dense	Mod-Very	Nonstrat	We

(5) Measured from USGS Topographic Maps (1:24000, 1:62500) in general vicinity of data point.

Base
Boulders:
Dry (S).
Igneous

depth
buried
upper unit.

2

			SURFACE SOIL DEVELOPMENT			SURFACE MORPHOLOGY			
ERING	STRUCTURE	CEMENTATION	PAVEMENT PATINA	B HORIZON	CALICHE ④ DEPTH / STAGE INCHES(mm) / (TABLE E-4)	SLOPE (:) ⑤	MAXIMUM MICRO- RELIEF FEET (METERS)	INCISION DEPTH WIDTH FEET (METERS)	STREAM GRADIENT (:) ⑤
d	Nonstrat	Mod	Fair/ Well	None	--- / II	---	2 (0.6)	12 (3.7) / 40 (12.2)	---
sh	Nonstrat	Strong	Fair/ None	None	--- / II	1.3	---	1 (.3) / 5 (1.5)	1.2
sh	Nonstrat	Weak	None/ None	None	None	0.8	2 (0.6)	None	0.8
sh	Nonstrat	Weak	None/ None	None	--- / None - I	1.0	---	None	---
y	Nonstrat	Mod - Strong	Poor/ None	Poor	--- / II	0.7 -	---	0.5 (.2) / 5 (1.5)	---
-	Nonstrat	Weak- Mod	Fair/ None	None	--- / II	---	---	1 (.3) / 3 (1)	---
-	Nonstrat	Weak	None	None	None	0.7	1 (0.3)	None	---
-	Nonstrat	Weak	None/ None	None	--- / None	1.0	---	None	---
-	Nonstrat	Weak- Mod	Fair/ None	None	13 (330) / II	0.8	---	-----	---
d	Nonstrat	Mod	Fair/ None	None	<1 (25) / II	---	0.5 (0.2)	1 (.3) / 20 (6.1)	---
ht	Nonstrat	Mod	Fair/ Poor	None	--- / II	1.2	---	2 (.6) / 5 (1.5)	---
e	Nonstrat	Weak	Poor/ None	None	None	2.7	---	2-3 (0.6-0.9) / 15-30 (4.6-9.1)	---
very	Nonstrat	Weak	Fair/ Fair- Poor	Poor	--- / II	---	2.5 (0.8)	4 (1.2) / 15 (4.6)	---
very	Nonstrat	Weak	Fair/ None	None	None	---	---	8 (2.4) / 100 (30.5)	---

PHYSICAL PROPERTIES COMPILED FROM
FIELD OBSERVATIONS - PAGE 2 OF 8
LECHUGUILLA DESERT, ARIZONA

VI SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE SAWSO

TABLE
B-1

FUGRO NATIONAL, INC.

3

STATION NUMBER ①	ENGINEERING GEOLOGY UNIT ②	DESCRIPTIVE NAME(S)	USCS SYMBOL(S)	GRADATION	PLASTICITY OF FINES	MAXIMUM GRAIN SIZE	APPROXIMATE	
							COBBLES BOULDERS (% OF TOTAL)	OR
LD-FS-46	A5yf (A5if)	Silty Sand w/ gravel	SM	Mod	None	Coarse Gravel	0	
LD-FS-47	A5iy	Fine Sand w/ silt	SP	Mod	None	Cobble	<1	
LD-FS-48	A5if	Sand	SP	Mod	None	Cobble	<5	
LD-FS-49	A5ic	Sand w/ silt, cobbles and boulders	SP	Poor	None	Boulder	10	
LD-FS-50	A5iyf (A5if)	Sand	SP	Mod	None	Cobble	<1	
LD-FS-54	A5iyf	Sand w/silt	SP	Mod	None	Gravel	0	
LD-FS-55	A5i	Sand	SP	Mod	None	Cobble	<5	
LD-FS-56	A5iyf	Sand	SP	Mod	None	Gravel	0	
LD-FS-57	A5if	Silty Sand	SM	Mod	None	Coarse Gravel	0	
LD-FS-58	A5if	Sand	SP	Mod	None	Fine Gravel	0	
LD-FS-60	Al on A5iy (A5i)	Sand	SP	Mod	None	Cobble	<1	
LD-FS-61	A5if	Silty Sand	SM	Mod	Low	Cobble	<5	
LD-FS-62	A5iy	Sand	SP	Mod	None	Coarse Gravel	0	
LD-FS-64	A5iyf	Sand	SP	Mod	None	Fine Gravel	0	

NOTES: ① Includes only complete data steps designated by symbol (▲) on Drawing 2.

② Where buried or mixed unit symbol occurs data are on unit listed first except where second unit is underlined. Where more than one layer is distinguished within one unit, numbering is from base to top.

③ Boulders, cobbles, and coarse gravel only. Rock type symbols: Metamorphic (M), Sedimentary (S), Igneous intrusive (I), or igneous extrusive (E).

④ Data in brackets indicate depth to and stage of caliche in buried unit. Caliche absent in upper unit.

MATERIAL PROPERTIES

SIZE	APPROXIMATE SIZE DISTRIBUTION				ROCK TYPE(S) ③	GRAIN SHAPE	MUNSELL COLOR	MOISTURE CONTENT	CONSISTANCY	WEATHERING ③	STRUCTURE	CEMENTATION
	COBBLES BOULDERS (% OF TOTAL)	% OF FRACTION ≤ 3 INCHES (76mm)										
		GRAVEL	SAND	FINES								
	0	10	75	15	Il	Subang- Subrnd	7.5YR 6/6	Dry	Med Dense	Fresh	Nonstrat	
	<1	5	85	10	M, Il	Subang- Subrnd	7.5YR 6/4	Dry	Med Dense	Fresh	Nonstrat	
	<5	5	85	5-10	M, Il	Subang- Subrnd	5YR 6/6	Dry	Med Dense	Fresh-Mod	Nonstrat	
	10	<5	85	10	M	Ang- Subrnd	5YR 5/6	Dry	Loose	Mod-Very	Nonstrat	
	<1	5	85-90	5-10	M, Il	Subrnd	---	Dry	Med Dense	Fresh- Slight	Nonstrat	
	0	5	85	10	---	Subang- Subrnd	7.5YR 7/6	Dry	Med Dense	Fresh	Nonstrat	
	<5	<1	95	<5	Il, M	Ang- Subang	5YR 5/6	Dry	Loose- Med Dense	Mod	Nonstrat	
	0	5	85-90	5-10	---	Subang- Subrnd	7.5YR 6/6	Dry	Med Dense	Fresh	Nonstrat	
	0	<1	80-85	15-20	M	Subang	2.5YR 5/6	Dry	Med Dense	Fresh	Nonstrat	
	0	5	90	5	Il	Ang- Subrnd	7.5YR 6/6	Dry	Med Dense	---	Nonstrat	
	<1	1	98	1	---	Subang- Subrnd	10YR 8/2 - 8/1	Dry	V. Loose Med Dense	Fresh- Slight	Lensed	
	<5	<1	85	15	S, M	Ang- Subang	10YR 7/8	Dry	Loose- Med Dense	Mod	Nonstrat	
	0	5	85	5-10	Il	Subang- Subrnd	7.5YR 7/4	Dry	Med Dense	Fresh	Nonstrat	
	0	5	90	5	Il	Ang- Subang	7.5YR 7/4	Dry	Med Dense	---	Nonstrat	

(3) Measured from USGS Topographic Maps (1:24000, 1:62500) in general vicinity of data point.

Coarse
symbols:
Sedimentary (S),
Igneous

Depth
in buried
upper unit.

			SURFACE SOIL DEVELOPMENT			SURFACE MORPHOLOGY			
RING	STRUCTURE	CEMENTATION	PAVEMENT PATINA	B HORIZON	CALICHE ④ DEPTH / STAGE INCHES(mm) / (TABLE E-4)	SLOPE (%) ⑤	MAXIMUM MICRO- RELIEF FEET (METERS)	INCISION DEPTH WIDTH FEET (METERS)	STREAM GRADIENT (%) ⑤
sh	Nonstrat	Weak	None/ None	None	None	1.5	3(1.0)	None	---
sh	Nonstrat	Weak	Poor/ None	None	0 / I	---	---	1 (0.3) / 5 (1.5)	---
Mod	Nonstrat	Weak	Fair/ None	None	--- / II	1.6	---	2 (.6) / 8 (2.4)	---
Very	Nonstrat	Weak	Mod/ Mod	Good	3(≈76) / II	4.0	---	-----	---
sh- t	Nonstrat	Weak	Fair/ None	None	--- / II	1.5	---	1 (.3) / 6 (1.8)	---
sh	Nonstrat	Weak	Poor- Fair/ None	None	None	---	---	-----	---
d	Nonstrat	Mod- Strong	Well/ Fair	Good	--- / II	1.2	---	-----	---
sh	Nonstrat	Weak	Poor- Fair/ None	None	None	---	---	1 (.3) / 4 (1.2)	---
sh	Nonstrat	Mod	Fair/ None	None	--- / II	0.7	---	None	---
---	Nonstrat	Mod	Fair/ None	None	1 (25) / I	---	---	1 (.3) / 3 (1)	---
sh- t	Lensed	Weak	None/ None	None	None	---	---	-----	1.3
---	Nonstrat	Weak	Well/ Well	None	0 / I	---	---	None	---
sh	Nonstrat	Weak	Poor/ None	None	None	---	---	1 (.3) / 3 (1)	---
---	Nonstrat	Weak	Fair/ None	None	None	1.0	---	1 (.3) / 6 (1.8)	---

PHYSICAL PROPERTIES COMPILED FROM
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LECHUGUILLA DESERT, ARIZONA

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE SAMSO

TABLE
B-1

FUGRO NATIONAL, INC.

3

STATION NUMBER ①	ENGINEERING GEOLOGY UNIT ②	DESCRIPTIVE NAME(S)	USCS SYMBOL(S)	GRADATION	PLASTICITY OF FINES	MAXIMUM GRAIN SIZE	APPROX.
							COBBLES BOULDER (% OF TOTAL)
LD-FS-66	A5if	Sand	SP	Mod	None	Fine Gravel	0
LD-FS-68	A5if	Sand	SP	Mod	None	Fine Gravel	0
LD-FS-70	A5iy	Silty Sand	SM	Mod	Low	Cobble	<1
LD-FS-71	A5i (layer 2)	Gravel w/ silt and sand	GP-GM	Mod	None	Boulder	5
LD-FS-71	A5i (layer 1)	Gravelly Sand	SP	Mod	None	Cobble	<1
LD-FS-71	A2 (buried)	Clay Layers	CL-CH	Poor	High	Silt	0
LD-FS-71	A2 (buried)	Silt Layers	ML-MH	Poor	Low	Sand	0
LD-FS-71	A2 (buried)	Sand Layers	SP	Poor	None	Gravel	0
LD-FS-72	A5i	Sand	SP	Mod	None	Cobble	<1
LD-FS-73	A5i (A5oc)	Sandy Gravel/ Gravelly Sand	GP-SP	Mod	None	Cobble	--
LD-FS-74	A5yf (A5if)	Silty Sand	SM	Mod	None	Fine Gravel	0
LD-FS-75	A5oc	Sandy Gravel	GP	Mod	None	Boulder	<1
LD-FS-76	A5yf	Silty Sand	SM	Mod	None	Coarse Gravel	0
LD-FS-77	A5iyc	Gravelly Sand	SP	Poor	None	Boulder	---

NOTES: ① Includes only complete data steps designated by symbol (▲) on Drawing 2.

② Where buried or mixed unit symbol occurs data are on unit listed first except where second unit is underlined. Where more than one layer is distinguished within one unit, numbering is from base to top.

③ Boulders, cobbles, and coarse gravel only. Rock type symbols: Metamorphic (M), Sedimentary (S), Igneous intrusive (I), or igneous extrusive (E).

④ Data in brackets indicate depth to and stage of caliche in buried unit. Caliche absent in upper unit.

	(% OF TOTAL)	GRAVEL	SAND	FINES	(3)							
vel	0	5	90	5	Il	Ang-Subang	7.5YR 6/6	Dry	Med Dense	---	Nonstrat	W
vel	0	5	90	5	Il	Ang-Subrnd	5YR 5/8	Dry	Med Dense	---	Nonstrat	M
	<1	<5	85	10-15	Il	Subang	7.5YR 6/6	Dry	Med Dense	Fresh-Slight	Nonstrat	W
	5	80	10	10	Il,M	Subang-Subrnd	----	Dry	Dense	Fresh-Very	Strat	Mod Str
	<1	20	80	0	Il,M	Subang-Subrnd	10YR 7/3	Dry	Dense	Fresh-Very	Strat	Mod Str
	0	0	0	100	---	-----	10YR 7/4	Dry	Dense	---	Lensed	
	0	0	5	95	---	-----	10YR 7/4	Dry	Dense	---	Lensed	
	0	5	95	0	---	-----	5 YR 5/8	Dry	Dense	---	Lensed	
	<1	<5	85-90	5-10	Il	Ang-Subang	7.5YR 6/8	Dry	Med Dense-Dense	Fresh-Slight	Nonstrat	W
	--	50	45-50	<5	Il,M	Subang	10YR 7/4	Dry	Med Dense-Dense	Fresh-Very	Strat (weak-mod)	
vel	0	5	75-80	15-20	---	Subang-Subrnd	7.5YR 7/6	Dry	Med Dense	---	Nonstrat	W
	<1	60	35	15	M,Il	Ang	7.5YR	Dry	Med Dense-Dense	Fresh-Very	Nonstrat	
	0	<5	80	15	---	Ang-Subrnd	7.5YR 7/6	Dry	Med Dense	---	Strat (weak)	W
	---	20	80	<1	M,Il	Subang	10YR 6/4	Dry	Med Dense	Fresh-Very	Nonstrat	W

(5) Measured from USGS Topographic Maps (1:24000, 1:62500) in general vicinity of data point.

Base
Labels:
Dry (S).
Igneous

depth
buried
upper unit.

2

			SURFACE SOIL DEVELOPMENT			SURFACE MORPHOLOGY			
WEATHERING (3)	STRUCTURE	CEMENTATION	PAVEMENT PATINA	B HORIZON	CALICHE (4) DEPTH / STAGE INCHES(mm) / (TABLE E-4)	SLOPE (%) (5)	MAXIMUM MICRO- RELIEF FEET (METERS)	INCISION DEPTH WIDTH FEET (METERS)	STREAM GRADIENT (%) (5)
---	Nonstrat	Weak	Fair/ None	None	6 (15) / I-II	---	---	2 (.6) / 6 (1.8)	---
---	Nonstrat	Mod	Fair/ None	Good	1 (25) / II	---	---	1.5 (.5) / 4 (1.2)	---
fresh- light	Nonstrat	Weak	Fair/ None	None	None	---	---	4 (1.2) / 30 (9.1)	---
fresh- ry	Strat	Mod- Strong	Mod/ Mod	Poor	5 (127) / II	---	---	35 (10.7) / 2000 (609.6)	---
fresh- ry	Strat	Mod- Strong	---/ ---	---	-----	---	---	-----	---
---	Lensed	Mod	---/ ---	---	-----	---	---	-----	---
---	Lensed	Mod	---/ ---	---	-----	---	---	-----	---
---	Lensed	Mod	---/ ---	---	-----	---	---	-----	---
fresh- light	Nonstrat	Weak	Fair/ None	Poor	1 (25) / I-II	---	---	4 (1.2) / 20 (6.1)	---
fresh- ry	Strat (weak-mod)	Mod	Well/ Well	Poor	--- / II-III	---	1 (0.3)	-----	---
---	Nonstrat	Weak	None/ None	---	46 (1168) / II	1.1	1 (0.3)	None	---
fresh- ry	Nonstrat	Mod	None/ Poor	---	--- / II	20.0	---	130 (39.6) / 400 (121.9)	---
---	Strat (weak)	Weak	Poor/ None	None	None	0.8	<1 (0.3)	None	---
fresh- ry	Nonstrat	None- Weak	Poor/ Poor- None	None	--- / I	---	4.5 (1.4)	-----	---

PHYSICAL PROPERTIES COMPILED FROM
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ON SITE INVESTIGATION
DEPARTMENT OF THE AIR FORCE SANSO

TABLE

B-1

FUGRO NATIONAL, INC.

3

STATION NUMBER ①	ENGINEERING GEOLOGY UNIT ②	DESCRIPTIVE NAME(S)	USCS SYMBOL(S)	GRADATION	PLASTICITY OF FINES	MAXIMUM GRAIN SIZE	COB- BOUL- DER OF
LD-FS-78	A5iyf	Sand	SP	Mod	None	Fine Gravel	
LD-FS-79	A5i	Sandy Gravel	GP	Mod	None	Cobble	
LD-FS-80	A1/A5yf	Sand	SP	Poor	None	Gravel	
LD-FS-81	A5oc	Sandy Gravel w/ cobbles and boulders	GP	Mod	None	Boulder	15
LD-FS-82	A5yf (A5if)	Silty Sand	SM	Mod	None	Gravel	
LD-FS-83	A5oc	Sand Gravel w/cobbles	GP	Poor	None	Cobble	
LD-FS-84	A5yf (A5if)	Silty Sand	SM	Mod	None	Coarse Gravel	
LD-FS-86	A5yf (A5if)	Silty Sand	SM	Mod	None	Gravel	
LD-FS-88	A5yf (A5if)	Silty Sand	SM	Mod	None	Fine Gravel	
LD-FS-89	A2	Gravelly Sand w/silt	SP-SM	Mod	Low	Gravel	
LD-FS-90	A5yf (A5if)	Silty Sand	SM	Mod	None	Coarse Gravel	
LD-FS-91	A5i	Gravelly Sand w/silt	SP	Mod	None	Cobble	
LD-FS-92	A5yf (A5if)	Silty Sand	SM	Mod	None	Fine Gravel	
LD-FS-93	A5iy	Sandy Gravel	GP	Mod	None	Cobble	

NOTES: ① Includes only complete data steps designated by symbol (▲) on Drawing 2.

② Where buried or mixed unit symbol occurs data are on unit listed first except where second unit is underlined. Where more than one layer is distinguished within one unit, numbering is from base to top.

③ Boulders, cobbles, and coarse gravel only. Rock type symbols: Metamorphic (M), Sedimentary (S), Igneous intrusive (I1), or igneous extrusive (I2).

④ Data in brackets indicate depth to and stage of caliche in buried unit. Caliche absent in upper unit.

MATERIAL PROPERTIES

MAXIMUM GRAIN SIZE	APPROXIMATE SIZE DISTRIBUTION				ROCK TYPE(S) ③	GRAIN SHAPE	MUNSELL COLOR	MOISTURE CONTENT	CONSISTANCY	WEATHERING ③	STRUCTURE
	COBBLES BOULDERS (% OF TOTAL)	OF FRACTION ≤ 3 INCHES (76mm)									
		GRAVEL	SAND	FINES							
Fine Gravel	0	<5	90	5	---	Ang-Subang	7.5YR 6/6	Dry	Med Dense-Dense	---	Nonstr
Cobble	---	60	35	<5	M	Subang	7.5YR 7/6	Dry	Dense	Very	Nonstr
Gravel	0	5	90	5	Il	Subang-Subrnd	7.5YR 7/4	Dry	Med Dense	---	Nonstr
Boulder	15-20	60	35	5	Il,M	Ang	7.5YR 7/4	Dry	Med Dense-Dense	Fresh-Very	Nonstr
Gravel	0	5	80	15	Il	Subang-Subrnd	7.5YR 7/4	Dry	Med Dense	---	Nonstr
Cobble	---	85	15	0	M,Il	Subang-Subrnd	10YR	Dry	Med Dense-Dense	Fresh-Very	Strat (weak)
Coarse Gravel	0	5	80	15	Il	Subang-Subrnd	7.5YR 7/4	Dry	Med Dense	---	Nonstr
Gravel	0	<5	80	15-20	---	Ang-Subrnd	7.5YR	Dry	Med Dense	---	Nonstr
Fine Gravel	0	<5	70	25	---	Ang-Subang	7.5YR 7/4	Dry	Med Dense	---	Nonstr
Gravel	0	15	70	<15	M	Subang	10YR 6/3	Dry	Med Dense	Mod	Nonstr
Coarse Gravel	0	<5	80-85	15	---	Ang-Subang	7.5YR 7/4	Dry	Med Dense-Dense	---	Nonstr
Cobble	---	20	70	10	M,Il	Ang-Subang	7.5YR 7/4	Dry	Med Dense	Very	Nonstr
Fine Gravel	0	5	80	15	---	Subang-Subrnd	7.5YR 6/4	Dry	Med Dense	---	Nonstr
Cobble	---	80	20	<1	M	Subrnd	---	Dry	Med Dense	Slight	Nonstr Imbrication

s, and coarse
 sh type symbols:
 Sedimentary (S),
 (Il), or igneous

(5) Measured from USGS Topographic
 Maps (1:24000, 1:62500) in
 general vicinity of data point.

Indicate depth
 caliche in buried
 present in upper unit.

			SURFACE SOIL DEVELOPMENT			SURFACE MORPHOLOGY			
ERGING	STRUCTURE	CEMENTATION	PAVEMENT PATINA	B HORIZON	CALICHE ④ DEPTH / STAGE INCHES(mm) / (TABLE E-4)	SLOPE (°) ⑤	MAXIMUM MICRO- RELIEF FEET (METERS)	INCISION DEPTH WIDTH FEET (METERS)	STREAM GRADIENT (°) ⑤
---	Nonstrat	Weak	Fair/ None	None	1 (25) / II	0.8	---	1.5 (0.5) / 6 (1.8)	---
y	Nonstrat	Weak- Mod	Well/ Well	Good	--- / II	1.2	---	None	---
---	Nonstrat	Weak	None/ None	None	None	0.5	---	2 (0.6) / 5 (1.5)	---
sh- y	Nonstrat	---	Well/ Well	None	--- / II	8.0	---	20 (6) / 100 (30)	2.0
---	Nonstrat	Weak	None/ None	None	[29 (736) / II]	1.5	1(0.3)	None	---
sh- y	Strat (weak)	Mod	---/ ---	---	--- / II	32.0	---	-----	---
---	Nonstrat	Weak	None/ None	None	[31 (787) / II]	1.5	1(0.3)	None	---
---	Nonstrat	Weak	None/ None	None	[18 (457) / II]	0.9	0.5 (0.2)	None	0.9
---	Nonstrat	Weak	None/ None	None	[32 (813) / II]	1.0	0.5 (0.2)	None	---
d	Nonstrat	Weak	Well/ Fair	None	--- / ---	---	---	-----	---
---	Nonstrat	Weak	None/ None	None	[32 (813) / II]	1.2	0.7 (0.2)	None	---
fy	Nonstrat	Weak	Well/ Well	Poor	6 (152) / II	0.8	3(0.9)	14 (4.3) / 75 (22.9)	---
---	Nonstrat	Weak	None/ None	None	[22 (559) / ---]	1.2	1(0.3)	None	1.2
ght	Nonstrat Imbrica- tion	None	Fair/ Poor	None	None	0.8	3(0.9)	7 (2.1) / 300 (91.4)	---

PHYSICAL PROPERTIES COMPILED FROM
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LECHUGUILLA DESERT, ARIZONA

ON SITE INVESTIGATION
DEPARTMENT OF THE AIR FORCE SAWSO

TABLE
B-1

FUGRO NATIONAL, INC.

3

STATION NUMBER ①	ENGINEERING GEOLOGY UNIT ②	DESCRIPTIVE NAME(S)	USCS SYMBOL(S)	GRADATION	PLASTICITY OF FINES	MAXIMUM GRAIN SIZE	APPROXIMATE
							COBBLES BOULDERS (% OF TOTAL)
LD-FS-94	A5if	Sand	SP	Mod	None	Cobble	<1
LD-FS-96	A5i	Gravelly Sand/ Silty Sand	SP-SM	Mod	None	Boulder	10
LD-FS-97	A5oc	Sandy Gravel w/ cobbles and boulders	GP	Mod	None	Boulder	40
LD-FS-98	A5iyf	Gravelly Sand w/ silt and cobbles	SP-SW	Mod	None	Cobble	15
LD-FS-99	A1/A5y	Sandy Gravel	GP	Mod	None	Boulder	---
LD-FS-100	A5yf	Silty Sand	SM	Poor	None- Low	Fine Gravel	0
LD-FS-101	A5iyf (A5if)	Silty Sand	SM	Poor	None	Gravel	0
LD-FS-102	A3d	Sand	SP	Poor	None	Sand	0
LD-FS-103	A5iyf	Silty Sand w/ gravel	SM	Mod	None	Cobble	---
LD-FS-105	A5iyf	Silty Sand	SM	Mod	None	Coarse Gravel	0
LD-FS-106	A5if	Sand	SP	Mod	None	Coarse Gravel	0
LD-FS-107	A5iyf	Sand	SP	Poor	None	Gravel	0
LD-FS-108	A5yf	Fine Sand	SP	Poor	None	Gravel	0
LD-FS-109	A1/A5yf	Sand	SP	Poor	None	Sand	0

NOTES: ① Includes only complete data steps designated by symbol (▲) on Drawing 2.

② Where buried or mixed unit symbol occurs data are on unit listed first except where second unit is underlined. Where more than one layer is distinguished within one unit, numbering is from base to top.

③ Boulders, cobbles, and coarse gravel only. Rock type symbols: Metamorphic (M), Sedimentary (S), Igneous intrusive (I1), or Igneous extrusive (I2).

④ Data in brackets indicate depth to and stage of caliche in buried unit. Caliche absent in upper unit.

MATERIAL PROPERTIES

MAXIMUM GRAIN SIZE	APPROXIMATE SIZE DISTRIBUTION				ROCK TYPE(S) (3)	GRAIN SHAPE	MUNSELL COLOR	MOISTURE CONTENT	CONSISTANCY	WEATHERING (3)	STRUCTURE
	COBBLES BOULDERS (% OF TOTAL)	% OF FRACTION IN 3 INCHES (76mm)									
		GRAVEL	SAND	FINES							
Gravel	<1	<5	85-90	5-10	M	Ang-Subrnd	5YR 5/8	Dry	Dense	Slight	Nonstrat
Boulder	10	30	50	20	M,I2	Subang	5YR 6/6	Dry	Med Dense-Dense	Very	Nonstrat
Boulder	40	80	20	<1	M,I1	Ang-Subang	---	Dry	Dense	Fresh-Very	Strat (weak)
Gravel	15	30	60	10	M	Subang-Subrnd	7.5YR 6/4	Dry	Med Dense	Mod	Nonstrat
Boulder	---	70	25	5	M	Subang-Subrnd	10YR	Dry	Loose	Fresh	Nonstrat
Fine Gravel	0	<1	75	25	I1	---	10YR 6/4	Dry	Loose-Med Dense	---	Nonstrat
Gravel	0	<1	85	15	I1	---	10YR 6/4	Dry	Med Dense-Dense	---	Nonstrat
Sand	0	0	>95	<5	--	Subrnd	10YR 6/4	Dry	Med Dense	---	Strat (weak); Lensed
Gravel	---	15	70	15	I1	Ang-Subang	10YR 6/4	Dry	Dense	Fresh-Mod	Nonstrat Strat (weak)
Coarse Gravel	0	5	80	15	I1	Subang	10YR 6/4	Dry	Med Dense	Mod	Nonstrat
Coarse Gravel	0	<1	95	5	I1	Ang-Subang	10YR 6/4-7.5YR 6/6	Dry	Med Dense	Mod	Strat (weak)
Gravel	0	1	98	<1	I1	Subrnd	---	Dry	Med Dense-Dense	---	Strat; Lensed (weak)
Gravel	0	<1	95	<5	---	Subang-Subrnd	10YR 6/6	Dry	Med Dense	---	Strat (weak)
Sand	0	<1	>99	0	---	Subrnd	10YR 6/4	Dry	Loose	---	Strat (well)

(3) Measured from USGS Topographic Maps (1:24000, 1:62500) in general vicinity of data point.

and coarse
type symbols:
Sedimentary (S),
I1), or igneous

Micro depth
depth in buried
at in upper unit.

2

			SURFACE SOIL DEVELOPMENT			SURFACE MORPHOLOGY			
WEATHERING ③	STRUCTURE	CEMENTATION	PAYEMENT PATINA	B HORIZON	CALICHE ④ DEPTH / STAGE INCHES(mm) / (TABLE E-4)	SLOPE (%) ⑤	MAXIMUM MICRO- RELIEF FEET (METERS)	INCISION DEPTH WIDTH FEET (METERS)	STREAM GRADIENT (%) ⑤
Slight	Nonstrat	Mod	Well/ Fair	None	2 (51) / II	1.5	---	1 (0.3) / ---	---
Very	Nonstrat	Mod	Well/ Well	Poor	5 (127) / II	1.3	---	-----	---
Fresh- Very	Strat (weak)	Mod- Strong	None/ Poor	None	--- / ---	---	---	40 (12.2) / 150 (45.7)	---
Mod	Nonstrat	Mod	Fair/ Poor- Fair	None	7 (178) / II	1.2	---	5 (1.5) / 100 (30.5)	1.2
Fresh	Nonstrat	None	None/ None	None	None	---	---	-----	---
---	Nonstrat	None	None/ None	None	None	0.6	---	None	---
---	Nonstrat	None	Poor- None/ None	None	6 (152) / II	---	---	5 (1.5) / 25 (7.6)	---
---	Strat (weak); Lensed	None	None/ None	None	None	---	---	None	---
Fresh- Mod	Nonstrat- Strat (weak)	None	Fair- Well/ None	None	None	3.2	---	-----	---
Mod	Nonstrat	None	Fair/ None	None	None	---	2.5 (0.8)	5 (1.5) / 150 (45.7)	---
Mod	Strat (weak)	Mod	Mod/ Poor	Poor	10 (254) / II	---	1-2 (0.3- 0.6)	None	---
---	Strat; Lensed (weak)	None-weak	Fair/ None	None	None	1.3	3 (0.9)	None	---
---	Strat (weak)	None	None/ None	None	None	1.0	1 (0.3)	None	---
---	Strat (well)	None	None/ None	None	None	0.4	3 (0.9)	-----	---

PHYSICAL PROPERTIES COMPILED FROM
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LECHUGUILLA DESERT, ARIZONA

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE SAUSO

TABLE

B-1

FUGRO NATIONAL, INC.

3

STATION NUMBER ①	ENGINEERING GEOLOGY UNIT ②	DESCRIPTIVE NAME(S)	USCS SYMBOL(S)	GRADATION	PLASTICITY OF FINES	MAXIMUM GRAIN SIZE	APPROX
							COBBLES BOULDERS (% OF TOTAL)
LD-FS-110	A5if	Sand	SP	Mod	None	Gravel	0
LD-FS-111	A5iyf	Sand	SP	Poor	None	Cobbles	<5
LD-FS-112	A5yf	Sand	SP	Poor	None- Low	Fine Gravel	0
LD-FS-113	A5if	Sand	SP	Mod	None	Cobble	<1
LD-FS-114	A5iy	Sand	SP	Mod	None	Cobble	<1
LD-FS-115	A1/A5yf	Sand	SP	Poor	None	Sand	0
LD-FS-120	A5iyf	Sand w/silt	SP	Poor	None	Gravel	0
LD-FS-121	A5if	Silty Sand w/ gravel	SM	Poor	None	Coarse Gravel	0
LD-FS-123	A5yf (A5if)	Gravelly Sand w/silt	SP	Mod	None	Gravel	0
LD-FS-124	A5if	Gravelly Sand w/ silt and cobbles	SP	Mod	None	Cobble	15
LD-FS-127	A5yf (A5if)	Sand	SP	Poor- Mod	None	Cobble	<1
LD-FS-128	A5ic	Sandy Gravel	GP-GW	Mod	None	Boulder	6
LD-FS-130	A5yf (A5if)	Sand	SP	Poor	None	Sand	0
LD-FS-131	A5if (M)	Sandy Gravel	GP	Mod	None	Cobble	5

NOTES: ① Includes only complete data steps designated by symbol (▲) on Drawing 2.

② Where buried or mixed unit symbol occurs data are on unit listed first except where second unit is underlined. Where more than one layer is distinguished within one unit, numbering is from base to top.

③ Boulders, cobbles, and coarse gravel only. Rock type symbols: Metamorphic (M), Sedimentary (S), Igneous intrusive (I¹), or Igneous extrusive (I²).

④ Data in brackets indicate depth to and stage of caliche in buried unit. Caliche absent in upper unit.

MATERIAL PROPERTIES

SIZE	APPROXIMATE SIZE DISTRIBUTION				ROCK TYPE(S) ③	GRAIN SHAPE	MUNSELL COLOR	MOISTURE CONTENT	CONSISTANCY	WEATHERING ③	STRUCTURE	CEMENTATION
	COBBLES BOULDERS (% OF TOTAL)	OF FRACTION ≤ 3 INCHES (76mm)										
		GRAVEL	SAND	FINES								
	0	<5	≈95	<5	Il	Subang	7.5YR 6/6	Dry	Med Dense-Dense	Mod	Nonstrat	M
	<5	5	95	<1	Il	Subang-Subrnd	10YR 7/4	Dry	Med Dense	Mod-Very	Strat (well)	M
vel	0	<1	95	<5	Il	Subang	10YR 6/4	Dry	Loose-Med Dense	---	Nonstrat	M
	<1	<5	95	<5	Il,M	Subang	7.5YR 6/6	Dry	Loose-Med Dense	Mod-Very	Nonstrat	M
	<1	<5	>95	<5	Il	Subang-Subrnd	10YR 7/4	Dry	Loose-Med Dense	Fresh-Mod	Strat (weak)	M
	0	0	95	<5	Il	Ang-Subang	10YR 6/4	Dry	Med Dense	---	Strat	M
	0	<1	90	10	Il	Subang	10YR 6/4	Dry	Med Dense	---	Nonstrat	M
	0	15	70	15	Il	Subang	7.5YR 5/6	Dry	Med Dense-Dense	Mod	Nonstrat	Weak
	0	15	75	10	Il	Subang-Subrnd	10YR 6/4	Dry	Med Dense-Dense	---	Nonstrat	None
	15	15-20	65-70	15	Il,M	Subang-Subrnd	7.5YR 6/4	Dry	Dense	Slight-Very	Nonstrat	Weak Str
	<1	≈5	>85	<10	Il,M	Subang	10YR 6/4	Dry	Med Dense-Dense	Mod	Strat (weak)	M
	6	55	40	<5	M	Ang-Subang	10YR 6/4	Dry	Med Dense-Dense	Fresh-Mod	Nonstrat	-

			SURFACE SOIL DEVELOPMENT			SURFACE MORPHOLOGY			
ERING	STRUCTURE	CEMENTATION	PAVEMENT PATINA	B HORIZON	CALICHE ④ DEPTH / STAGE INCHES(mm) / (TABLE E-4)	SLOPE (%) ⑤	MAXIMUM MICRO- RELIEF FEET (METERS)	INCISION DEPTH WIDTH FEET (METERS)	STREAM GRADIENT (%) ⑤
ed	Nonstrat	Mod	Fair/ None- Poor	Poor	2 (51) / II	1.6	3.5 (1.1)	3 (0.9) / <20 (6.1)	---
Very	Strat (well)	None	None/ None	None	None	---	3(0.9)	3-4 (0.9-1.2) <20 (6.1)	---
	Nonstrat	None	None/ None	None	None	0.9	2(0.6)	None	---
Very	Nonstrat	Mod	Poor- Fair/ None	Poor	7 (25) / I-II	---	3(0.9)	5-6 (1.5-1.8) 30 (9.1)	---
h-Mod	Strat (weak)	None	Poor/ None	None	None	---	---	5-10 (1.5-3)/ 75 (22.9)	---
	Strat	None	None/ None	None	None	0.5	---	3-4 (0.9-1.2)/ 40-50(12.2-15.2)	---
	Nonstrat	None	Poor/ None	None	None	---	---	2 (0.6) / 10 (3.0)	---
ed	Nonstrat	Weak-Mod	Fair/ None- Poor	Poor	12 (305) / II	10.0	4(1.2)	5-6 (1.5-1.8)/ 100 (30.5)	---
	Nonstrat	None-Weak	Well/ None	----	[9 (229) / ---]	1.6	2 (0.6)	None	---
light- ry	Nonstrat	Weak- Strong	Fair- Well/ Poor	Poor	16 (406) / I-II	---	2.5 (0.8)	4-5 (1.2-1.5)/ 30 (9.1)	---
ed	Strat (weak)	Weak	None/ None	None	None	---	4(1.2)	None	---
sh-	Nonstrat	---	Well/ Fair- well	None	None	6.4	2(0.6)	4-5 (1.2-1.5)/ 20-25 (6.1-7.6)	---
	Nonstrat	None	Fair/ Poor	None	[4 (102) / II]	1.5	3(0.9)	None	---
	Nonstrat	---	Well/ Fair- Well	Poor	3 (76) / II	3.2	2(0.6)	4-5 (1.2-1.5)/ 20-25 (6.1-7.6)	---

PHYSICAL PROPERTIES COMPILED FROM
FIELD OBSERVATIONS - PAGE 7 OF 9
LECHUGUILLA DESERT, ARIZONA

UX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE SAWSO

TABLE
B-1

FUGRO NATIONAL, INC.

3

STATION NUMBER ①	ENGINEERING GEOLOGY UNIT ②	DESCRIPTIVE NAME(S)	USCS SYMBOL(S)	GRADATION	PLASTICITY OF FINES	MAXIMUM GRAIN SIZE	APP
							COBBLE BOULDER (% OF T)
LD-FS-133	A5iyf	Sand	SP	Poor- Mod	None	Gravel	0
LD-FS-134	A5i	Gravelly Sand w/cobbles and boulders	SP-SW	Mod	None	Boulder	16
LD-FS-136	A5if	Gravelly Sand	SP	Poor- Mod	None	Cobble	<1
LD-FS-137	S	Sandy Gravel w/silt, bould- ers & cobbles	GM	Poor- Mod	None	Boulder	55
LD-FS-139	A3s	Fine Sand	SP	Poor	None	Cobble on Surface	—
LD-FS-140	A5if	Sand	SP	Mod	None	Cobble	<5
LD-FS-142	A5if	Sand	SP	Mod	None	Cobble	<1
LD-FS-143	A5if	Sand	SP	Poor	None	Gravel	0
LD-FS-144	A5if	Gravelly Sand w/silt	SP	Mod	None	Coarse Gravel	0
LD-FS-145	A5if	Sand	SP	Poor	Low	Coarse Gravel	0
LD-FS-148	A5if	Sand w/gravel	SP	Mod	None	Coarse Gravel	0
LD-FS-149	A5if	Sand w/silt	SP	Poor- Mod	None	Gravel	0
LD-FS-150	A5if	Sand	SP	Mod	None	Coarse Gravel	0
LD-FS-151	A5iyf	Sand	SP	Poor- Mod	None	Coarse Gravel	0

NOTES: ① Includes only complete data stops designated by symbol (▲) on Drawing 2.

② Where buried or mixed unit symbol occurs data are on unit listed first except where second unit is underlined. Where more than one layer is distinguished within one unit, numbering is from base to top.

③ Boulders, cobbles, and coarse gravel only. Rock type symbols: Metamorphic (M), Sedimentary (S), Igneous intrusive (I?), or Igneous extrusive (I2).

④ Data in brackets indicate depth to and stage of caliche in buried unit. Caliche absent in upper unit.

MATERIAL PROPERTIES

SIZE	APPROXIMATE SIZE DISTRIBUTION				ROCK TYPE(S) ③	GRAIN SHAPE	MUNSELL COLOR	MOISTURE CONTENT	CONSISTANCY	WEATHERING ③	STRUCTURE	CE
	COBBLES BOULDERS (% OF TOTAL)	OF FRACTION ≤ 3 INCHES (76mm)										
		GRAVEL	SAND	FINES								
	0	<5	90	5-10	M	Ang-Subang	10YR 6/4	Dry	Dense	----	Nonstrat	N
	16	30	65	5	M	Subang-Subrnd	10YR 7/4	Dry	Med Dense-Dense	Mod	Strat (weak)	W
	<1	15-20	70-75	<10	M	Subang-Subrnd	7.5YR 6/6	Dry	Med Dense	Mod	Nonstrat	W
	55	50	35	15	Il,M	Ang-Subrnd	----	Dry	Dense-V. Dense	Very	Nonstrat	W
on	---	<5	>95	0	M	Subrnd-Rnd	10YR 6/4	Dry	Dense	Mod	Nonstrat	M
	<5	5	90	5	M	Subang-Subrnd	2.5YR 5/8	Dry	Med Dense	Slight	Nonstrat	W
	<1	<5	90	5-10	M	Ang-Subrnd	5YR 6/4	Dry	Med Dense	Slight-Mod	Nonstrat	W
	0	<5	>95	<5	M	Subrnd	10YR 6/4	Dry	Med Dense	Fresh-Mod	Nonstrat	W
	0	25	65	10	M	Subang	7.5YR 7/4	Dry	Med Dense	---	Nonstrat	Mo
	0	<1	90	<10	---	Subang-Subrnd	5YR 5/6	Dry	Med Dense-Dense	---	Nonstrat	Mo
	0	10	85	5	---	Subang-Subrnd	7.5YR 6/4	Dry	Loose-Med Dense	---	Nonstrat	W
	0	<5	≈90	≈10	M	----	7.5YR 5/6	Dry	Dense	---	Nonstrat	Mo
	0	5-10	80-90	5-10	---	Ang-Subang	7.5YR 7/4	Dry	Med Dense	Fresh	Nonstrat	W
	0	<1	95	5	M	Subang	10YR 6/4	Dry	Med Dense	---	Nonstrat	Mo

(3) Measured from USGS Topographic Maps (1:24000, 1:62500) in general vicinity of data point.

Base
Labels:
Dry (S),
Igneous

depth
buried
upper unit.

			SURFACE SOIL DEVELOPMENT			SURFACE MORPHOLOGY			
WEATHERING (3)	STRUCTURE	CEMENTATION	PAVEMENT PATINA	B HORIZON	CALICHE (4) DEPTH / STAGE INCHES(mm) / (TABLE E-4)	SLOPE (%) (5)	MAXIMUM MICRO- RELIEF FEET (METERS)	INCISION DEPTH WIDTH FEET (METERS)	STREAM GRADIENT (%) (5)
----	Nonstrat	None- Weak	Poor/ None	None	None	0.7	3 (0.9)	6-8 (1.8-2.4) / 50 (15.2)	0.6
Mod	Strat (weak)	Weak- Mod	Well/ Poor- Fair	Poor	5 (127) / I-II	---	---	15 (4.6) / 50 (15.2)	---
Mod	Nonstrat	Weak	Well/ Fair- Well	Poor	5 (127) / I	---	3 (0.9)	3-5 (0.9-1.5) / 20 (6.1)	---
Very	Nonstrat	Weak- Mod	---/ ---	---	---- / ---	---	---	-----	---
Mod	Nonstrat	Mod	Poor/ None	None	4 (102) / I-II	---	---	5 (1.5) / -----	---
Slight	Nonstrat	Weak- Mod	Well/ Poor	Good	11 (279) / II	---	---	3 (0.9) / 10 (3.0)	---
Slight- Mod	Nonstrat	Weak- Mod	Fair/ Poor- Fair	None	1 (25) / II	3.1	---	3-4 (0.9-1.2) / 10-15 (3.0-4.6)	3.1
Fresh- Mod	Nonstrat	Weak- Mod	Poor/ Poor	Poor	--- / II	---	4 (1.2)	-----	---
---	Nonstrat	Mod	Fair/ Poor	None	10 (254) / II	---	---	2 (0.6) / 4 (1.2)	---
---	Nonstrat	Mod	Poor- Fair/ None	Good	0 / II	---	0.5 (0.2)	None	---
---	Nonstrat	Weak- Mod	Fair/ None	None	2 (51) / II	---	---	1-2 (0.3-0.6) / 4-6 (1.2-1.8)	---
---	Nonstrat	Mod- Strong	Fair/ Poor	Poor	--- / II	2.0	1 (0.3)	None	---
Fresh	Nonstrat	Weak- Mod	Fair/ None	None	1 (25) / II	1.0	---	None	---
---	Nonstrat	None	Poor/ None	None	None	1.5	---	None	---

PHYSICAL PROPERTIES COMPILED FROM
FIELD OBSERVATIONS - PAGE 8 OF 9
LECHUGUILLA DESERT, ARIZONA

WE SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE SAUSO

TABLE
B-1

FUGRO NATIONAL, INC.

3

STATION NUMBER ①	ENGINEERING GEOLOGY UNIT ②	DESCRIPTIVE NAME(S)	USCS SYMBOL(S)	GRADATION	PLASTICITY OF FINES	MAXIMUM GRAIN SIZE	APPROXIMATE	
							COBBLES BOULDERS (% OF TOTAL)	GR
LD-FS-152	A5yf (A5if)	Silty Sand	SM	Mod	None	Coarse Gravel	0	
LD-FS-154	A5yf (A5if)	Silty Sand	SM	Mod	None	Coarse Gravel	0	
LD-FS-166	A5if	Silty Sand	SM	Mod	None	Coarse Gravel	0	
LD-FS-170	A5yf (A5if)	Silty Sand	SM	Mod	None	Fine Gravel	0	
LD-FS-177	A5iyf	Sand w/silt and gravel	SP	Poor- Mod	None	Cobble	<1	1
LD-FS-182	A1/A5yf	Sand w/silt	SP	Poor	None	Coarse Cobble	0	
LD-FS-184	A5i	Gravelly Sand w/cobbles	SP	Mod	None	Cobble	10	
LD-FS-186	A5i	Sandy gravel w/cobbles and boulders	GP	Mod	None	Boulder	30-50	

NOTES: ① Includes only complete data stops designated by symbol (▲) on Drawing 2.

② Where buried or mixed unit symbol occurs data are on unit listed first except where second unit is underlined. Where more than one layer is distinguished within one unit, numbering is from base to top.

③ Boulders, cobbles, and coarse gravel only. Rock type symbols: Metamorphic (M), Sedimentary (S), Igneous Intrusive (I1), or igneous extrusive (I2).

④ Data in brackets indicate depth to and stage of caliche in buried unit. Caliche absent in upper unit.

MATERIAL PROPERTIES

[illegible]

ed coarse
age symbols:
imentary (S).
(S). or igneous

⑤ Measured from USGS Topographic Maps (1:24000, 1:62500) in general vicinity of data point.

Scale depth
who is buried
in 1955 unit.

			SURFACE SOIL DEVELOPMENT			SURFACE MORPHOLOGY			
WEATHERING (1)	STRUCTURE	CEMENTATION	PAVEMENT PATINA	B HORIZON	CALICHE (4) DEPTH / STAGE INCHES(mm) / (TABLE E-4)	SLOPE (%) (5)	MAXIMUM MICRO- RELIEF FEET (METERS)	INCISION DEPTH WIDTH FEET (METERS)	STREAM GRADIENT (%) (5)
---	Nonstrat	Weak	None/ None	None	[19(482.6) / II]	0.9	0.5 (0.2)	None	---
---	Lensed	Weak	None/ None	None	[30(762.0) / II]	0.8	1(0.3)	None	---
---	Nonstrat	Mod	Well/ None	None	1 (25) / II	---	---	1-2 (0.3-0.6) / 3-8 (0.9-2.4)	---
---	Nonstrat	Weak	None/ None	None	[37(939.8) / ---]	1.5	1(0.3)	None	---
Mod	Nonstrat	None	Poor/ None	None	None	1.8	3(0.9)	5 (1.5) / 40 (12.2)	---
---	Lensed	Weak	None/ None	None	None	0.7	---	---	0.7
Mod	Nonstrat	Mod	Well/ Fair	None	4(102) / II	2.0	---	1 (0.3) / 4 (1.2)	---
Mod Very	Strat (weak)	Strong	Poor/ Poor	----	0 / II-III	10.0	---	10-20(3.0-6.1) / 50-60(15.2-18.3)	1.4

PHYSICAL PROPERTIES COMPILED FROM
FIELD OBSERVATIONS - PAGE 9 OF 9
LECHUGUILLA DESERT, ARIZONA

UX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE SAUSO

TABLE
B-1

FUGRO NATIONAL, INC.

[illegible]

- * 1. None
- 2. Iron Oxide
- 3. Chrysocolla
- 4. Calcite
- 5. Epidote

NOTE: Data compiled from Rock Conditions and Material Resources data sheets (Form 204-Appendix E). Dashes indicate a lack of specific data at these locations.

SUMMARY OF ROCK FOLIATION/BEDDING LECHUGUILLA DESERT, ARIZONA

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - SAMSO

**TABLE
B-3**

FUGRO NATIONAL, INC.

AD-A113 449

FUGRO NATIONAL INC LONG BEACH CA

F/6 8/7

MX SITING INVESTIGATION GEOTECHNICAL EVALUATION OF LUKE BOMBING--ETC(U)

JAN 78

F04704-77-C-0010

UNCLASSIFIED

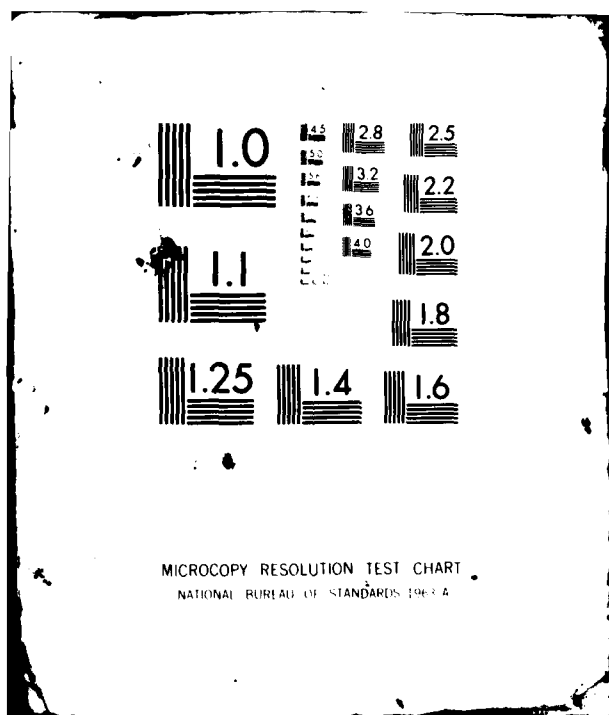
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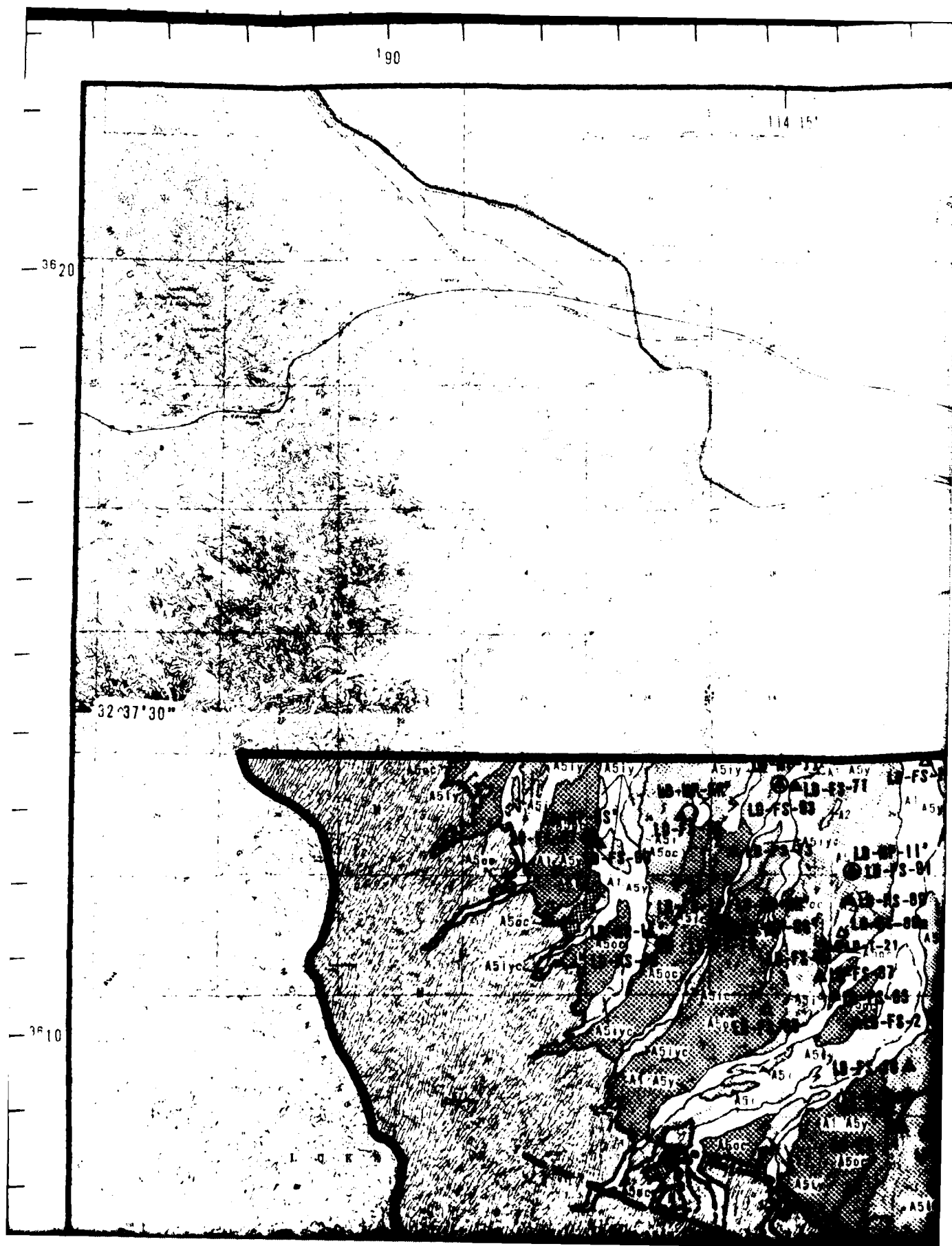
NL

2 2
A 40-04



END	END
DATE	DATE
FIMED	FIMED
5 82	5 82
DTIC	DTIC





14 7'30"

LD-FS-190

14 00

LD-ES-1

ASIV

LD-A-11

ASIV

LD-ES-1

LD-FS-1

LD-FS-1

LD-ES-1

LD-FS-1

LD-FS-1

ASIV

LD-FS-1

LD-FS-1

ASIV

LD-T-2

LD-C-1

LD-FS-1

ASIV

LD-FS-1

ASIV

LD-FS-1

ASIV

LD-FS-1

ASIV

LD-FS-1

ASIV

LD-FS-1

ASIV

32 37

4

EXPLANATION

LD-FS-122
▲

Geologic Field Station; Denotes a complete data stop, including data sheets, photographs, and detailed field observations.

LD-FS-13
△

Geologic Field Station; Denotes a supplemental data stop for photographs and/or detailed field observations.

LD-MP-AA'
○

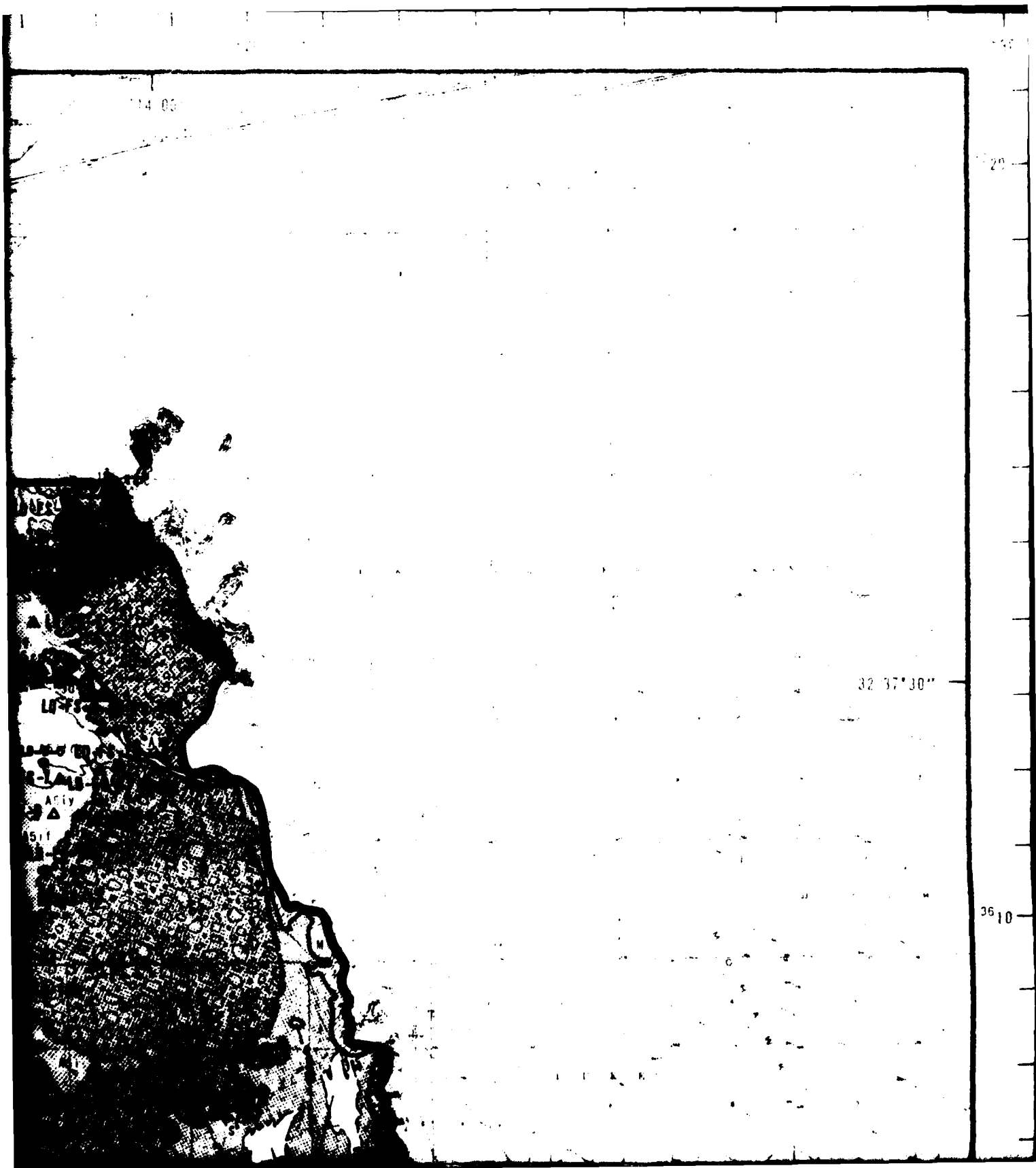
Microrelief Profiles; Denotes location which may coincide with geologic field stations.

A — A'
LD-CS-AA'

Line of Geologic Cross Section.

LD-A, B, C, D, T, OR S-1
●

Activity locations (borings, trenches, shallow seismic refraction lines).



3603

3602

3601

3600

3599

3598

3597

3596

3595

3594

3593

3592

3591

3590

3589

3588

3587

6

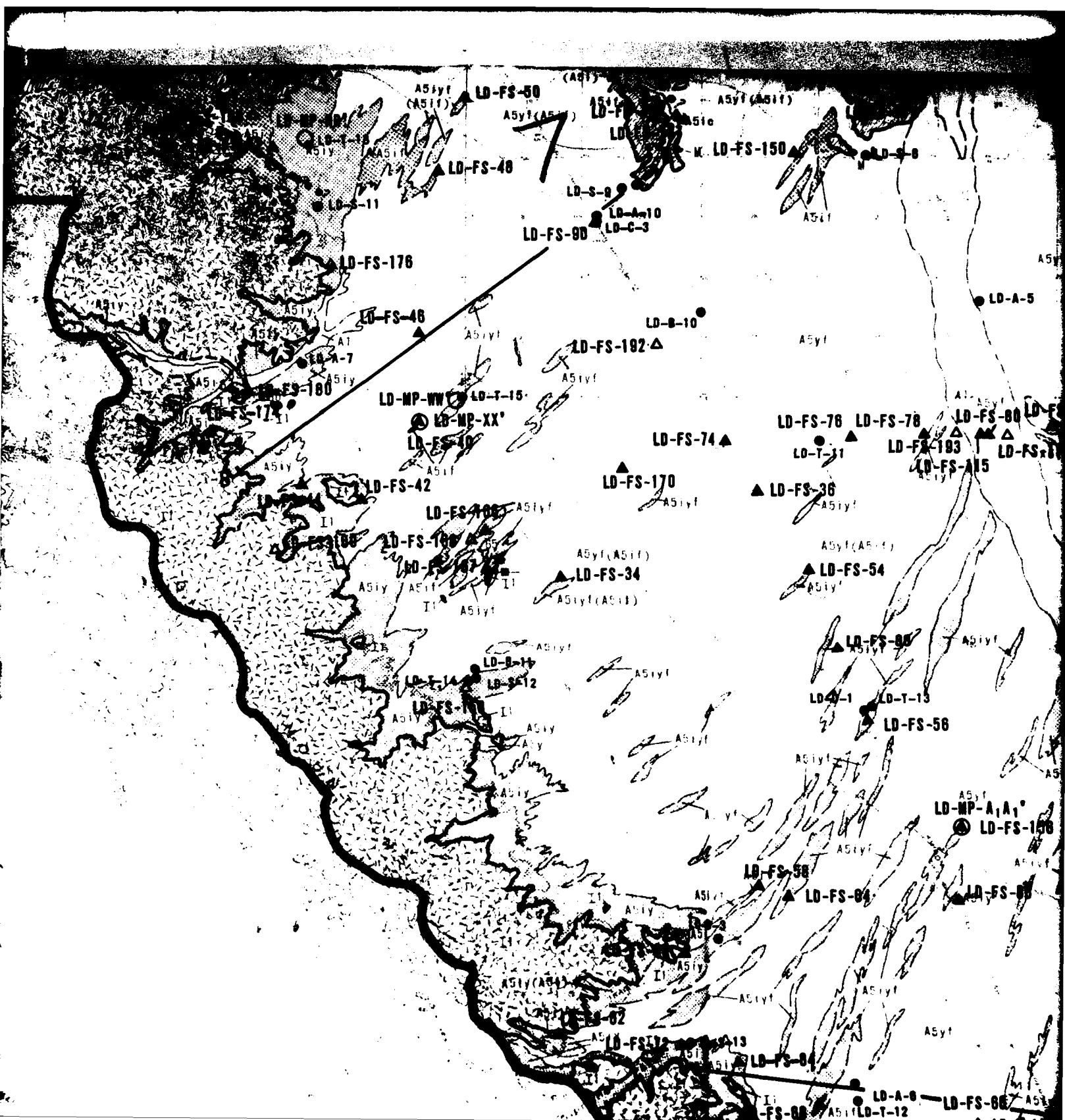
32 30'

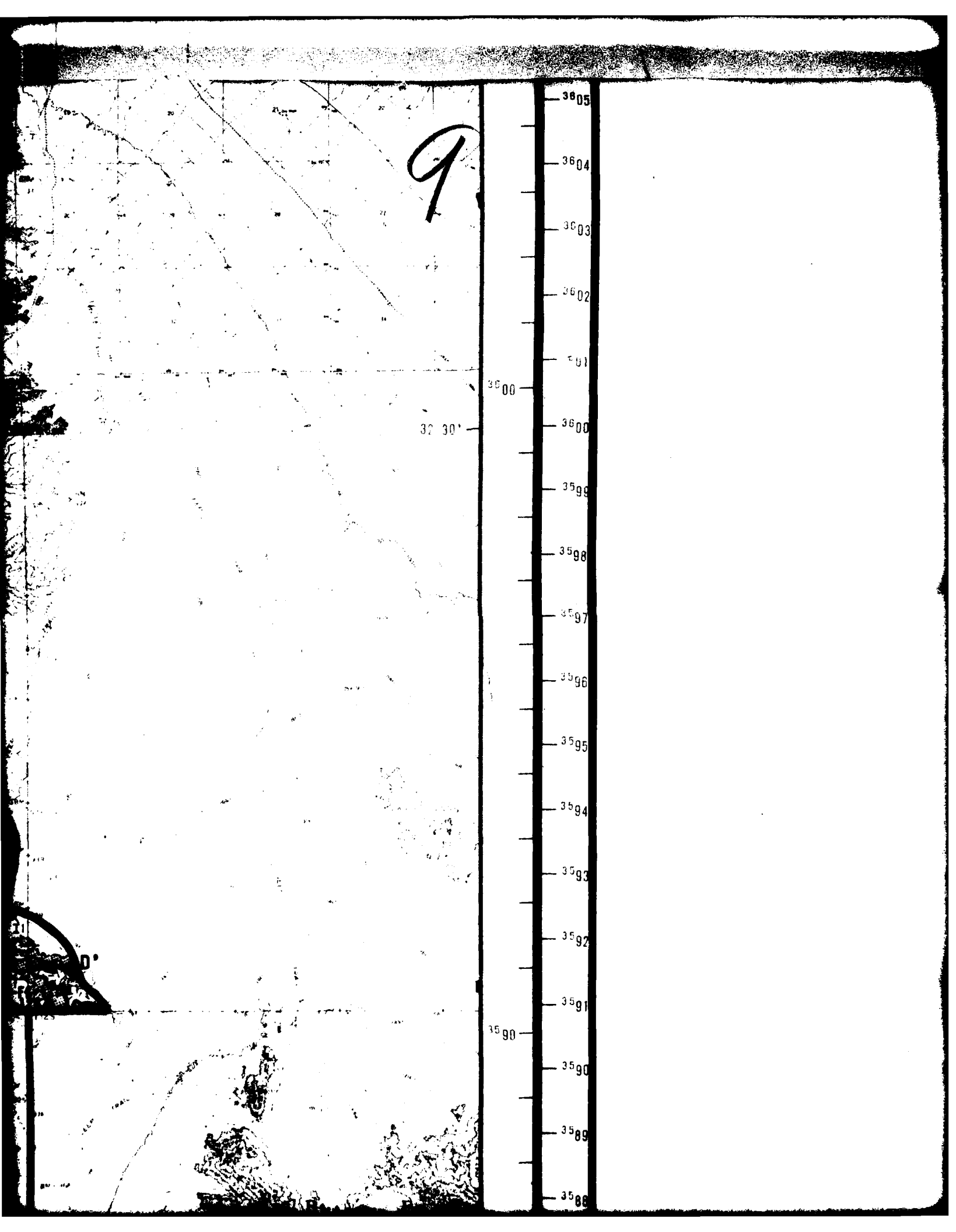
3590

E R A N G E

DAVIS FLAIN

Mountain





3585

32°22'30"

3584

10

3583

3582

3581

3580

3579

3580

3578

3577

3576

3575

3574

3573

3572

3571

32°15'

3570

3569

3568

184°00' E

3570°00' N

190

YUMA

LESER

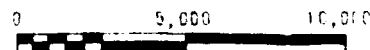
YUMA CO



STATUTE MILES



NAUTICAL MILES

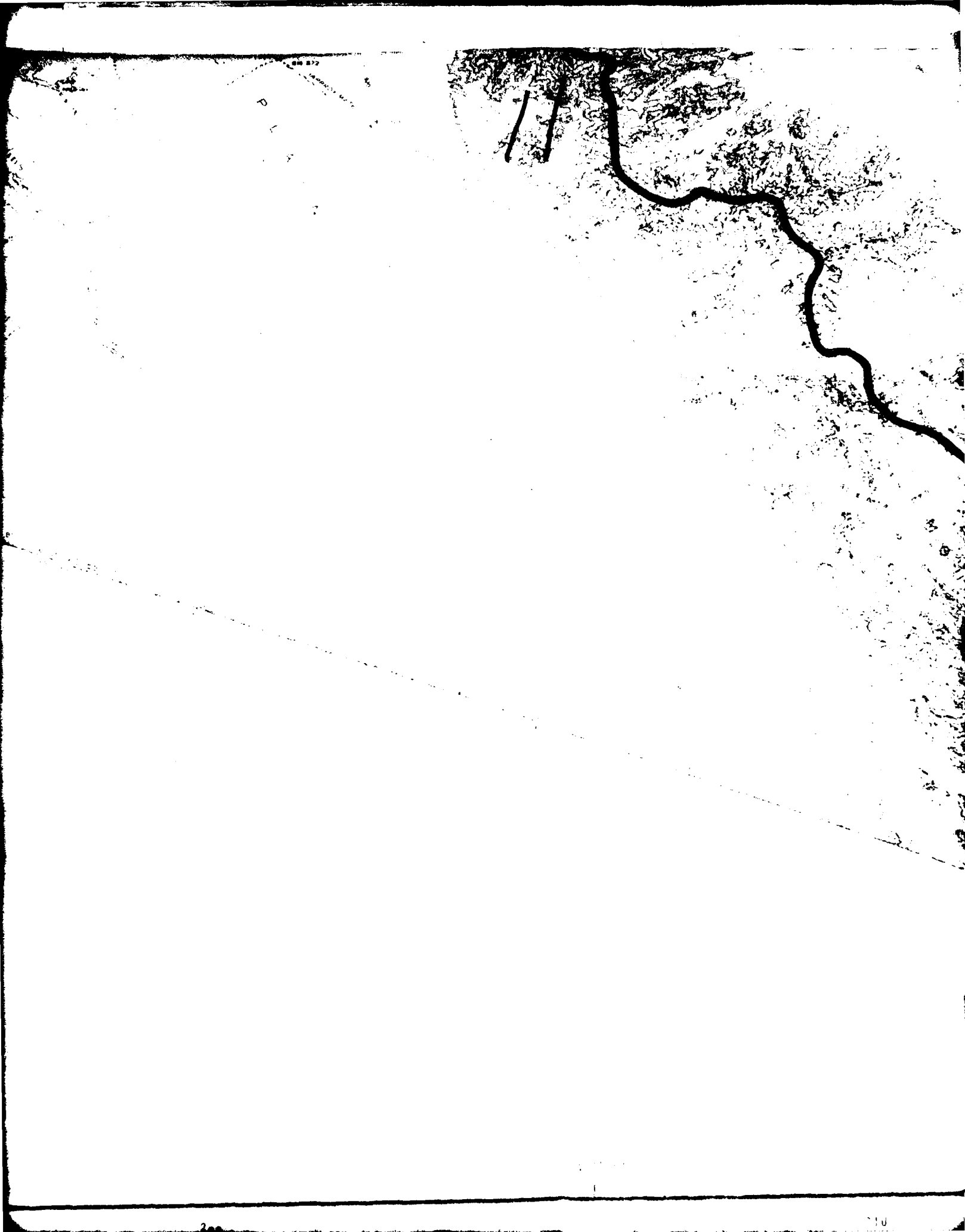


FEET



KILOMETERS

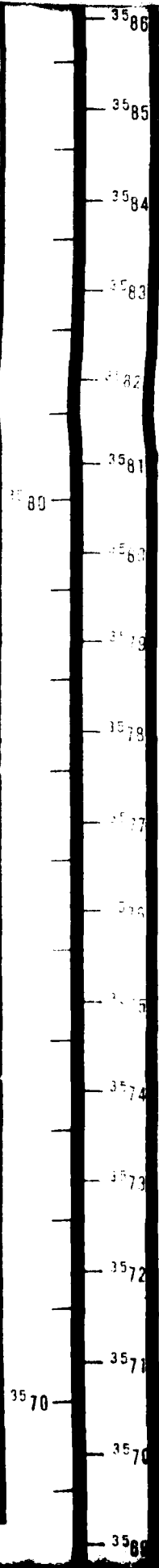
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12

TECHUGUILLA

DESERT



32° 22' 30"

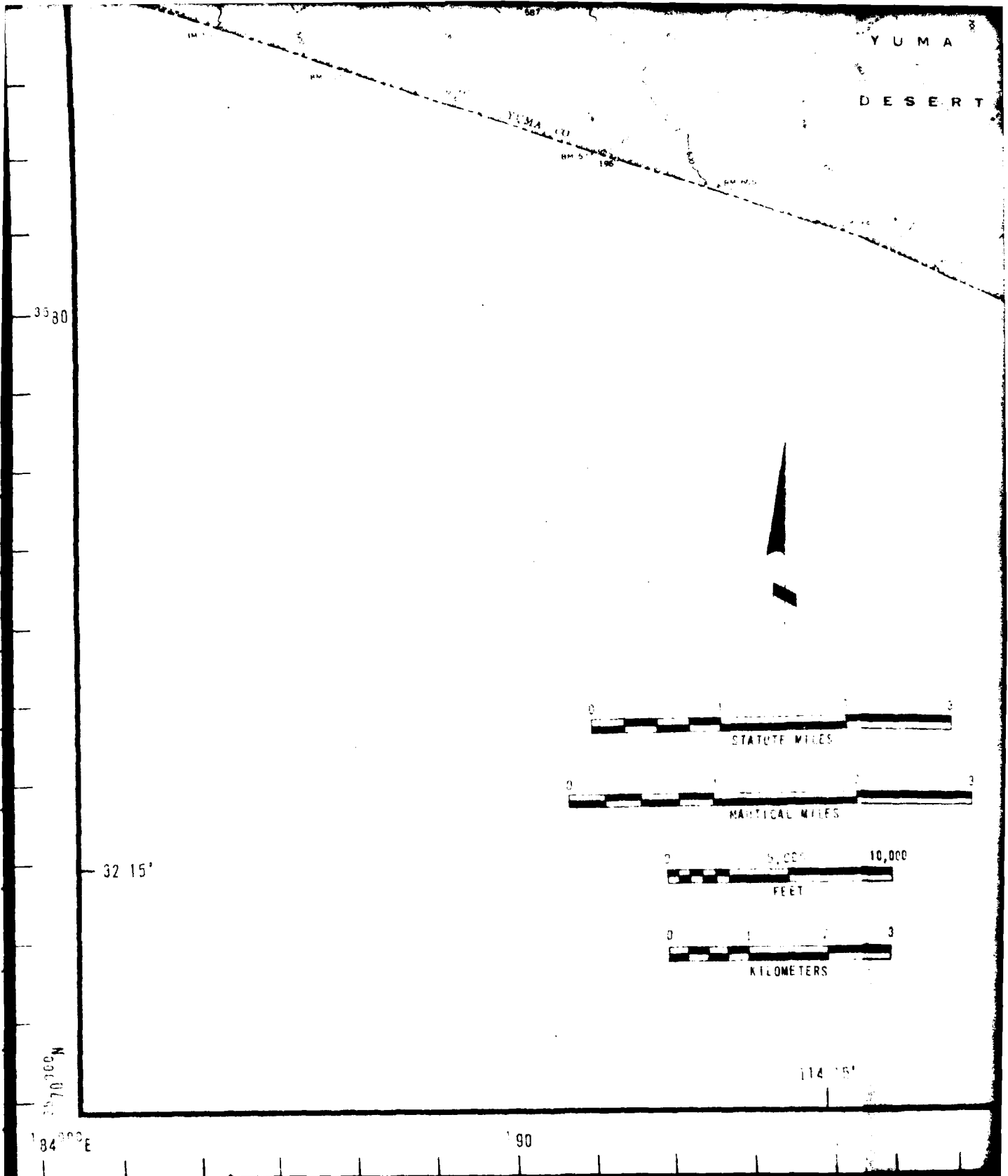
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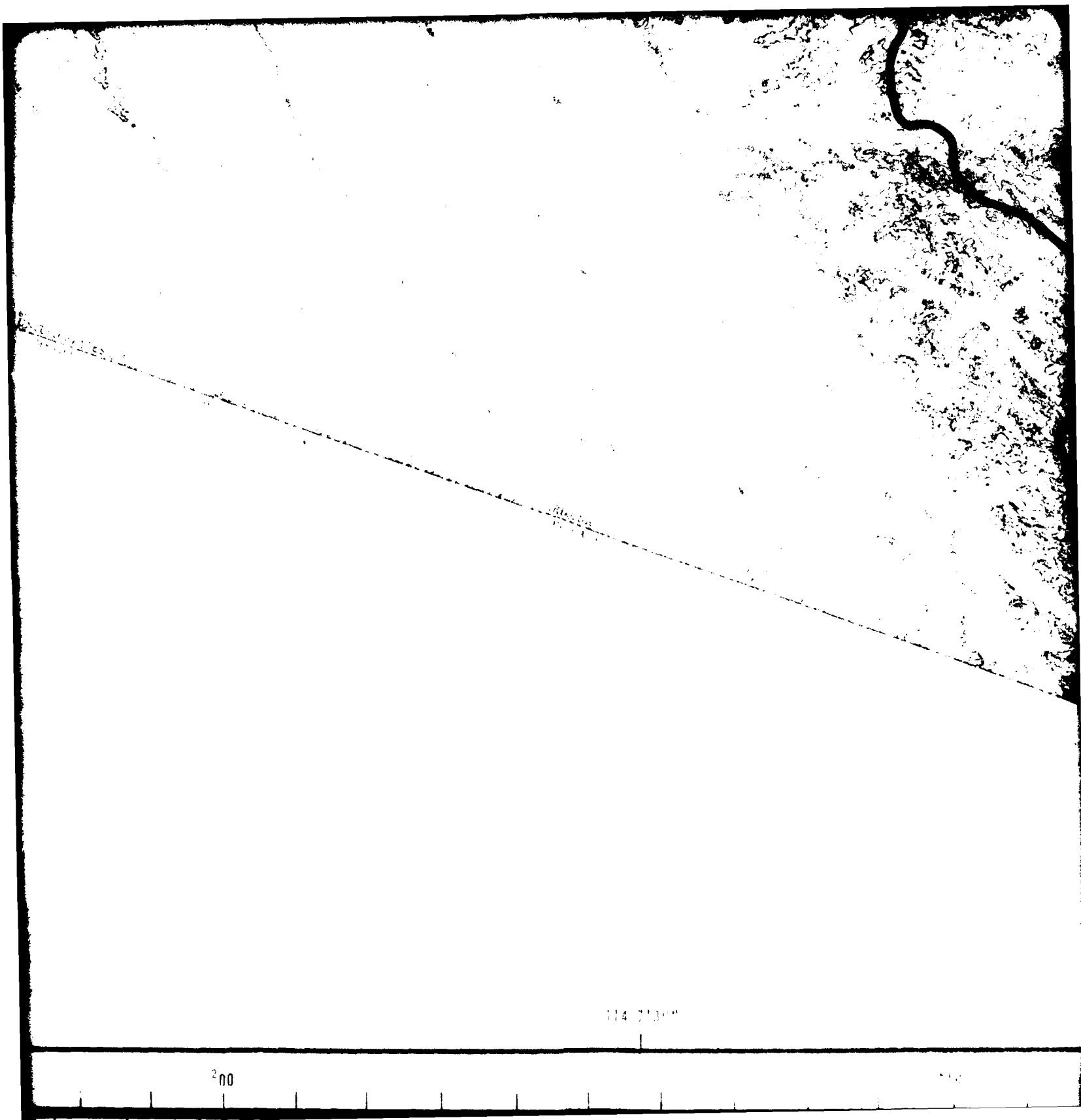
TECHUGUILLA

DESERT

TECHUGUILLA
MEXICO

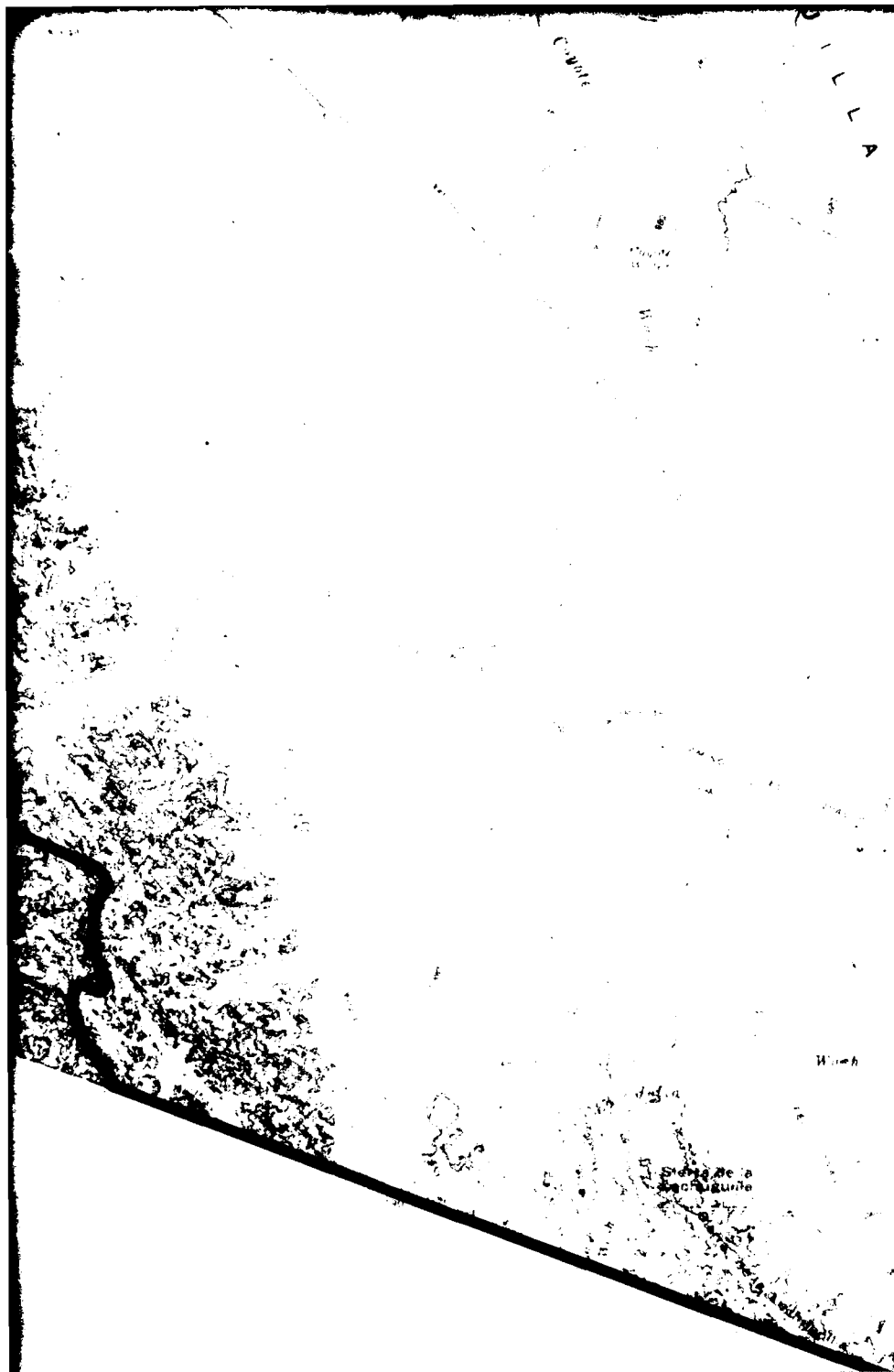
111 00'





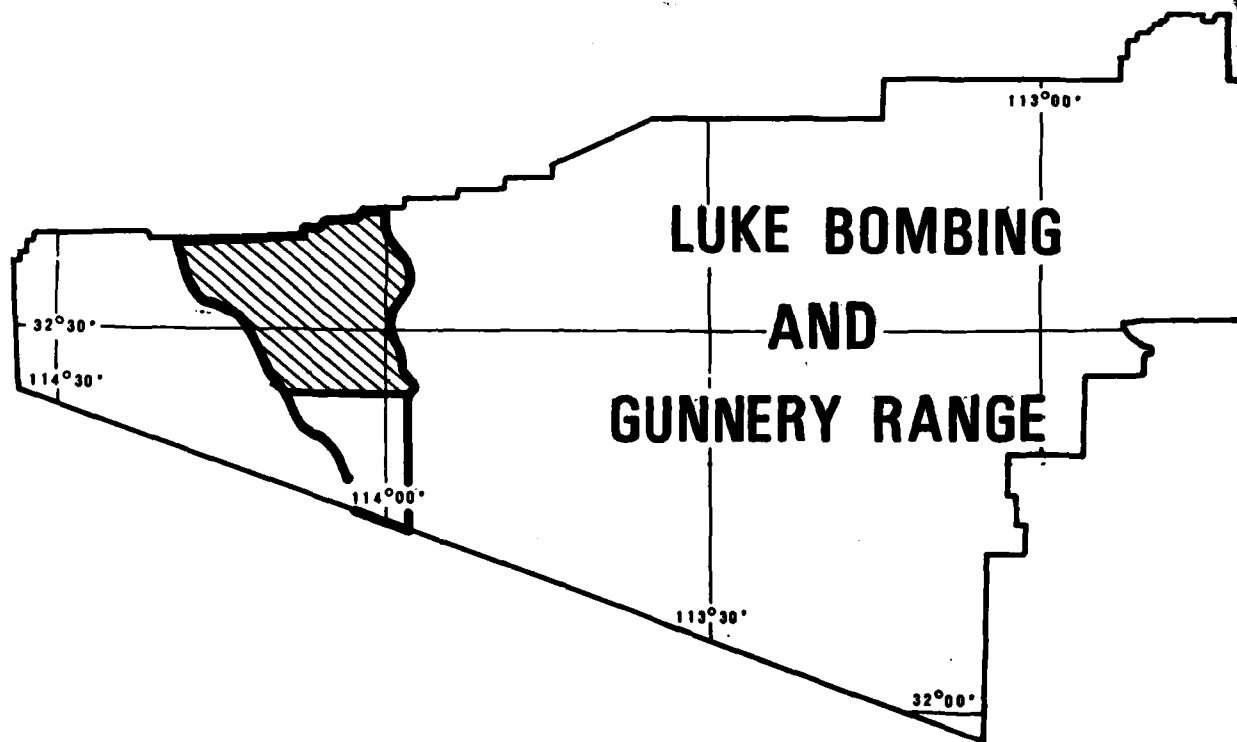
114 213-11

200



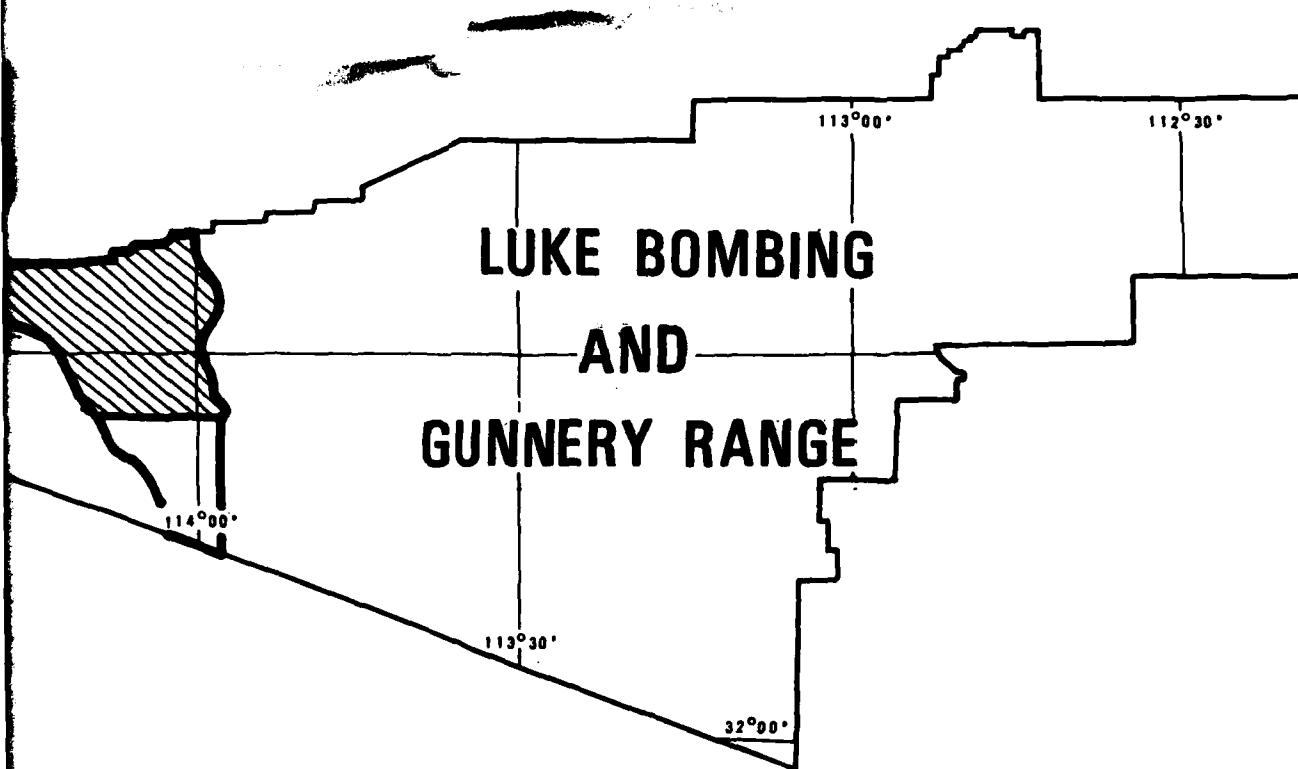
16

NOTE: Explanation of geologic units is contained on Drawing 1 Geologic Map of
Lechuguilla Desert, Arizona



ACTIVITY
LECHUGUILLA

Note: Explanation of geographic names is contained on drawing 1. Geographic map of
Lechuguilla Desert, Arizona



ACTIVITIES LOCATION MAP
LECHUGUILLA DESERT, ARIZONA

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - SAMSO

DRAWING

B-1

FUGRO NATIONAL INC.

DAT
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DATE
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— 8